VIKING LABORATORIES INC.

SIEMENS

05-C-148.1

LEVEL TRACER Type K211

200 to 4000 Hz

Technical Information

Order No.: S45034-K211-G214-03-7670

SIEMENS AKTIENGESELLSCHAFT

Herausgegeben von
Published by

SIEMENS AKTIENGESELLSCHAFT
Bereich Weitverkehrstechnik, Nachrichten-Meßgeräte

D-8000 MÜNCHEN 25
Postfach 704

Tel.: (0811) 7221
Telex: 524721

Änderungen vorbehalten
Subject to change without notice

Vervielfältigung sowie Verwertung des Inhaltes ist unzulässig, soweit nicht ausdrücklich zugestanden.
Duplication of this information and utilization of its contents is prohibited unless explicitly authorized.
SIEMENS AKTIENGESELLSCHAFT

C O N T E N T S

Description

I. Application 1
II. Electrical Data 3
III. Function and Layout 5
A. Transmitting Section 5
B. Receiving Section 6
C. Jack Field and Attachment Circuits 8
D. Power Supply Unit 9
E. Layout 10
IV. Accessories, Dimensions, and Weights 12

Instructions for Use 13
C. Transmission Measurement, General 18
D. Impedance Measurement 21
E. Return Loss Measurement 22
F. Comparing Level Measurement 25
G. Comparing Impedance Measurement 27
H. Adjustment of Impedance Compensators 28
I. Structural Return Loss 29
IV. Preparation of Measurements Records 32

Notes on Maintenance 2-01

Fault Eliminating
I. Testing Instructions
1. General 3-01
2. General Function Check 3-03
3. Frequency Response of Transmitting Section . . 3-07
4. Frequency Response of Receiving Section 3-08
5. Adjusting the Calibrating Level 3-09
6. Checking the Screen Graticule/
Frequency Graduation 3-10
7. Checking the Screen Graticule/
Decibel Graduation 3-11

8. Checking the Screen Graticule/
Ohm Graduation 3-12
9. Function Check of the Pushbutton
"Frequency Marker" 3-13
10. Checking the jacks "Deflecting Plates" 3-14
11. Adjustment of the Cam Contacts for the
Measurement of X/N 3-15
12. Adjusting the Cams for Omitting the
Zone of the Tone Dialling Signal 3-16
13. Checking the 6-dB Step for Z = 600 Ω 3-17
14. Checking the 1.8-dB Step 3-18
15. Checking the 6-dB Step for Z = 900 Ω 3-19
16. Checking the Source Impedances 3-20
17. Checking the Transmitting Level 3-21
18. Checking the 800-c/s Wave Trap 3-22
19. Checking the Transmitting Frequency 3-23
20. Checking the receiving Level 3-24
II. Further Informations . . . . . will be supplied

Parts List

I. Introductory Remarks 4-01
II. Transmitting Subassembly Type Rel 35 K 76g1a . . . 4-05
III. Oscillator Subassembly Type Rel 35 K 112b 4-09
IV. Motor Subassembly Type Rel 35 K 235a1a 4-10
V. Receiving Subassembly Type Rel 35 K 77g 4-11
VI. Power Supply Subassembly Type Rel 35 K 78c 4-17
VII. Edge Lighting Adapter Type Rel 35 K 236a 4-20
VIII. Mechanical Spare Parts 4-21

Circuit Diagrams 5-01

I. APPLICATION

The Level Tracer contains the transmitting and receiving facilities for all measurements on quadripoles that can be reduced to voltage measurements and therefore represents a complete measuring setup. Its transmitting and receiving sections are calibrated in decibel as referred to 1 mw (dbm). For measurements on two-terminal networks the device contains attachment circuits which can be directly brought in the measuring circuit by means of a function switch. The level tracer is used instead of level oscillator and level meter whenever short measuring times are a factor: The measuring result is displayed as a trace versus frequency on the screen of a cathode ray tube. The values can be read before the screen on a graticule graduated in level and frequency. It is also possible to photograph the measuring results or pencil them down on corresponding graphic sheets.

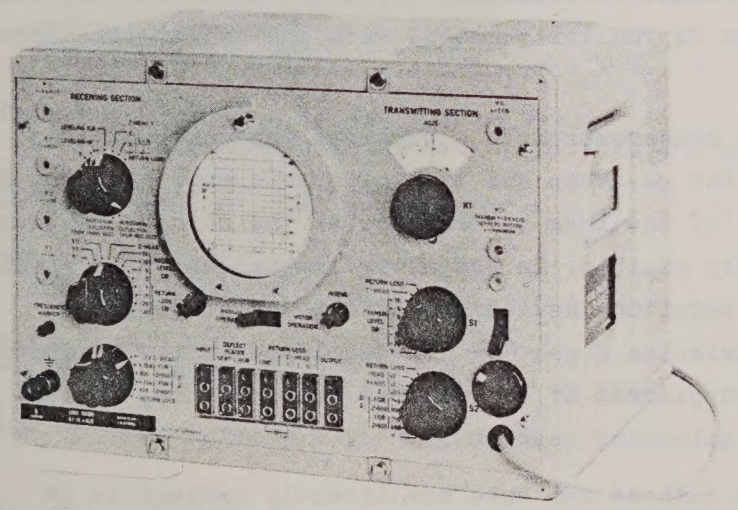


Fig. 1 Level Tracer

The frequency range extends from 200 to 4000 c/s so that also the adjoining regions beyond the CCI telephone band (300 to 3400 c/s) appear on the screen. The frequency can either be continuously controlled with a motor drive or set by hand pointwise.

The receiving section derives the frequency-dependent horizontal deflecting voltage from the signal under test so that the transmitting and the receiving section need not be directly interconnected. With measurements on telephone circuits it is thus also possible to use at the far end any desired level oscillator capable of swept operation. This leaves at the receiving end the possibility of adding frequency markers to the screen trace by means of the transmitting section of the local unit.

With measurements of telephone circuits trouble can occur when the level oscillator sweeps through the response band of the tone dialling receivers. To prevent this, the critical frequencies are skipped and the device supplies a different frequency in this narrow band whose mid-frequency can be chosen according to the respective tone dialling frequency.

The built-in attachment circuits serve for measuring return loss and impedance magnitude. With this device it is thus possible to set in a minimum of time the equalizers of VF line repeaters, to find the component values of balancing networks, to match negative-impedance repeaters or to locate, for instance, faults according to Küpfmüller's method with the aid of impedance curves.

Also possible are comparison measurements in a way that the curve of the specimen X is traced out in the go sweep and that of a reference standard N in the return sweep. Because of the long persistence of the cathode ray tube both curves are simultaneously visible. In comparing impedances it is possible to determine apart from magnitude deviations also phase differences, since in this setting the variables X and $\frac{X+N}{2}$ are displayed on the luminous screen. This is a valuable supplement of return loss measurements, for instance in fault locating on balancing networks.

The deflecting plates of the cathode ray tube are directly accessible at panel jacks to allow the cathode ray tube also to be used independently. Plug-actuated contacts on the jack disconnect the receiving section from the tube, when these jacks are used.

The operating voltages are supplied via the built-in power supply unit by the AC mains with a nominal voltage of 110, 130, 220, or 240 v.

II. ELECTRICAL DATA

Frequency range . . . . . 200 to 4000 c/s

Transmitting Section

Frequency sweep . . . . . about logarithmic

Sweep rate at 50 c/s . . . . . 0.25 c/s

Suppression for tone dialling frequency . . . can be set for a narrow band between approx. 1500 and 4000 c/s

Frequency error . . . . . ±3% ±20 c/s

additionally with ±10% mains voltage variations . . . . . ±5% ±30 c/s

Transmitting level, can be switched . . . . . -20 to +10 dbm

Transmitting level error at 800 c/s and a load Z = Z_i or, for $Z_i \sim 0\ \Omega$, with Z > 300 Ω . . . . . ±0.3 db

additionally with mains voltage variations of ±10% . . . . . ±0.2 db

Frequency response of the transmitting level as referred to 800 c/s . . . . . ±0.1 db

Source impedance, can be switched . . . . . ~0; 600; 900 Ω

Harmonic distortion with termination > 300 Ω . . . . . < 1%

Balance-to-unbalance ratio (common mode suppression) . . . . . > 35 db

Hum voltage (unweighted) . . . . . > 70 db

Receiving Section

Level ranges, as referred to zero line, can be switched . . . . . -30 to +20 db

Scale range (ordinate) . . . . . -20 to + 3 db

Minimum readable level . . . . . -50 dbm

Level error at 800 c/s, as referred to zero line . . . . . ±0.2 db

additionally with ±10% mains voltage variations . . . . . ±0.1 db

Scale graduation error from +3 db to -5 db . . . . . < ±0.2 db

Frequency response of the indication, as referred to 800 c/s and zero line . . . . . ≤ ±0.2 db

Error of the frequency indication (abscissa) on the zero line . . . . . ±5% ±25 c/s

additionally for the full range of the level scale . . . . . ±3% ±20 c/s

additionally with ±10% mains voltage variations . . . . . ±3% ±20 c/s

Input impedance, can be switched . . . . . 600, 900 Ω; > 25 kΩ

Common mode suppression (balance ratio) . . . . . > 43 db

Abscissa length . . . . . 50 mm (2")

Ordinate length . . . . . 59 mm ($2^5/16$")

Impedance Measurement

Impedance range in three sub-ranges . . . . . from 50 Ω to 1.6 (2.9) kΩ

Impedance error for full-scale value . . . . . ±10 (±15)%

Return Loss Measurements

Measuring range . . . . . 0 to 50 db

Measuring error for X and N between 200 and 2000 Ω, as referred to the zero line . . . . . < 1 db

Mains Connection . . . . . 110/130 (220/240) v ±10%; 40 to 60 c/s; approx. 85 va

III. FUNCTION AND LAYOUT

Fig. 2 shows the basic circuit diagram of the entire device; the full circuit diagram is included in the Circuit Diagrams part.

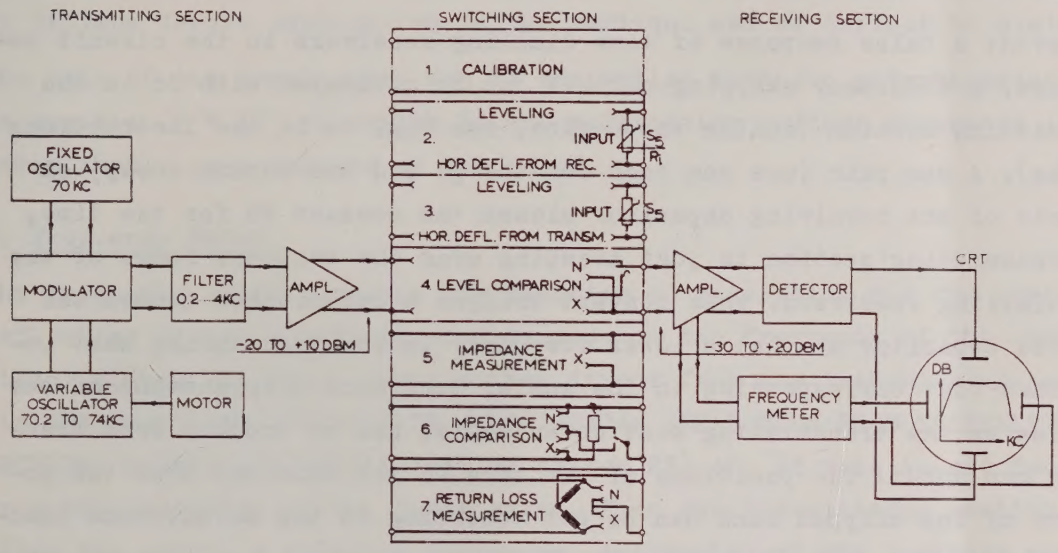


Fig. 2. Block schematic

A. Transmitting Section

The transmitting section operates on the beat-frequency principle. With the revolving capacitor K1 the frequency of the controlling oscillator (tube 1) can either be swept periodically by a motor drive (switch S6) over the range (swept operation) or set manually pointwise. The fixed 70-kc/s oscillator (tube 2) feeds the modulator with the controlled voltage; it is stabilized by an incandescent-lamp bridge. The mixing products after the modulator Md include essentially components of the sum and the difference frequency; the following low-pass filter selects therefrom the component of the difference frequency. By way of a divider which, for setting the transmitting level, can be switched with S1, the signal reaches a two-stage degenerative audio amplifier (tubes 3,4). The output voltage is taken from the low-impedance winding of transformer Ü2.

The source impedance ($Z_i \sim 0\ \Omega$) can be matched to the nominal value of the specimen, by the balanced insertion into circuit of resistors (600 Ω and 900 Ω) with switch S2. Since the device is calibrated in decibel above 1 mw, the output power is stabilized by simultaneous switching of the degenerative coupling in the repeater (tubes 3, 4) as the transfer is made from 600 to 900 Ω.

To prevent a false response of tone dialling receivers in the circuit under test, a frequency skipping circuit can be activated with S8 in the transmitting section (inside the device, see Fig. 1a in the Instructions for Use). A cam pair (one cam each for the go and the return sweep) on the axle of the revolving capacitor closes the contact NS for the time, the transmitting section is just sweeping over the response range of the tone dialling receivers. This contact bridges a capacitance across the variable capacitor so that a lower frequency is produced during that period than that corresponding to the scale. Such mere displacement of the band leaves the transmitting section activated and no trouble from transients can occur. The positions of the cams on the axle and thus the positions of the skipped band can be set according to the actual tone dialling frequency (see Instructions for Use).

B. Receiving Section

It consists of a level meter circuit and a frequency meter circuit for detecting amplitude and frequency of the received signal. The results are displayed as components of a rectangular coordinate system on the screen of a CRT to give one measuring spot at a time; as the frequency is varied, the measuring curve is traced out accordingly.

a. Level Meter Circuit

Via the function switch S3 the voltage under test reaches the input transformer. With S5 this high-impedance input can be switched to 600 Ω or 900 Ω, combined with automatic variation of the transformation ratio of the input transformer in the ratio 600/900 for the power measurement. By way of the level range switch S4 and a two-stage degenerative amplifier (tubes 6, 7) the signal reaches the rectifier stage tube 8 in

a voltage doubler connection. Two floating bias voltages for the vertical deflecting plates, which can be jointly controlled with the potentiometer P3, are in series with the two balanced halves of the DC voltage. With P3 one sets thus the vertical position of the luminous spot with short-circuited amplifier input (switch S4 at " ▼ I"). The DC voltage is smoothed by filters before application to the vertical set of deflecting plates.

The gain of the level meter can be controlled with the potentiometer P2, if in position " ▼ II" of switch S4 the calibrating voltage generated in the power supply unit appears at the input.

b. Frequency Meter

The frequency meter performs the function of generating for the horizontal deflecting plates a voltage that depends on the frequency of the applied signal alone. Its input comes either direct from the transmitting section (in the positions LEVELING-IN / HORIZONTAL DEFLECTION FROM TRANSMITTING SECTION, Z-MEAS and RETURN LOSS of switch S3) or, if this is not feasible, from the amplifier of the level meter. When the transmitting section supplies the input, a reliable horizontal deflection of the luminous spot is even obtained at frequencies for which the applied signal drops below the lowest readable value such as in measuring filter curves (see annexed Fig. 6). In the position LEVELING-IN / HORIZONTAL DEFLECTION FROM RECEIVING SECTION an auxiliary contact $S3^{I}$ transfers the input of the frequency meter from the transmitting section to the output of the level meter amplifier.

In the frequency meter a preamplifier stage (tube 9) and following diode section limit the voltage in a way that the output voltage is largely independent of the input amplitude. This output passes a discriminator which in turn produces a frequency-dependent voltage. The following rectifier circuit (tube 11) and the filter elements equal those of the level meter circuit. In series connected with this horizontal deflecting voltage are two floating DC voltages which can be jointly controlled with P5 for setting the origo of the CRT graticule (calibrating operation ▼ V). Besides the gain in the frequency meter circuit can be set with P4. Both potentiometers serve accordingly for calibrating beginning and end of the frequency scale.

When transmitting section and receiving section are at different places, it is possible to use at the receiving end the transmitting section not employed for the test itself for adding a frequency marker to the screen trace by pushing the button T. For the time the button is down the frequency meter

circuit receives in such case its input not from the level meter circuit but via contact T III from the local transmitting section. Contacts T I and T II apply simultaneously 20 v AC to the vertical deflecting plates so that the frequency marker appears as a vertical line on the screen .

C. Jack Field and Attachment Circuits

a. The jack field (with shielded triple jacks) is arranged at the center of the front panel below the picture screen. When the desired mode of operation is selected on switch S3, the output of the transmitting and the input of the receiving section are connected to the corresponding panel jacks (see Instructions for Use) and Attachment Circuits.

When the connecting cords are plugged into the jacks LINE which are in parallel to "X", a plug-actuated break contact connects a capacitor (2 µf) into the b-wire. This allows a substitution for the ring-blocking capacitors at the line end, if they cannot be measured together with the line, e.g., in determining the return loss.

The panel jacks VERT and HOR allow direct access to the deflecting plates of the cathode ray tube, so that the CRT section can also be used independently. By plug-actuated break contacts in the terminal jacks HOR and VERT the leads from the receiving section are automatically disconnected.

b. The impedance measurement is reduced to a voltage measurement across the specimen under an impressed constant current (high-impedance generator). The voltage drop across the specimen is proportional to the magnitude of the impedance in such case. For an upward and downward expansion of the impedance range in either direction (x 0.5, x 2) the impressed current can be varied with switch S2. It is so chosen that a voltage level of about 0 db appears across the specimen.

c. The return loss is measured with a built-in bridge circuit. The reactor D6 establishes the two accurately identical fixed arms of this bridge, the impedances X and N to be intercompared make the two other arms. Since the transmitting level (switch S1 in position RETURN LOSS) is constantly +6 db

with $Z_i \sim 0\ \Omega$, the voltage level across the specimen is 0 db with bridge balance; the measured receiving level, with opposite sign, gives the return loss .

d. For comparing measurements the axle of the revolving capacitor carries two switching cams with contacts S11, S22 which connect the high-impedance input of the level meter alternatingly to the jacks "X" and "N".

If the specimen X and a reference standard N are connected to these jacks, respectively, the go sweep on the CRT will display the level values of X, and the return sweep those of N. The two curves are simultaneously visible, since the screen of the CRT has sufficient persistence (annexed Fig. 6).

In the same way the complex impedance X (go sweep) and half the phasor sum of specimen X and standard N (return sweep) are traced out in comparing impedances. The lastnamed sum equals the complex impedance X only if both impedances are equal by magnitude and phase .

D. Power Supply Unit

This subassembly supplies all operating voltages required. The device can be run on AC mains with a nominal voltage of 110/130 v or 220/240 v, depending upon the insertion of the relocate fuse S9 and the soldered links established on the power transformer. The 110-v motor for the revolving capacitor is connected to one half of the primary so as to be unaffected by input voltage adjustments; it is turned on with S6.

The operating voltages for the CRT as well as the bias voltages for the horizontal and vertical deflections must be independent of mains voltage variations. Their rectifier circuits are therefore powered from a 20-kc/s generator whose amplitude is stabilized by an incandescent-lamp bridge in the feedback circuit. This generator produces also the constant AC voltage required for calibration of the receiving section. The anode voltage for the transmitting and the receiving section as well as the heater voltages are unregulated.

E. Layout

In the slide-in chassis the receiving section is mounted at the left, the transmitting section at the right, with the front panel controls arranged correspondingly (Fig. 1). This leaves the view of the screen unobstructed even while the right hand of the operator is setting the transmitting frequency.

When the knob K1 is rotated, the friction in the slide-clutch must also be overcome. The clutch connects the motor via a gearing unit to the variable capacitor so that the motor is not forcefully rotated when the knob K1 is turned. The scale is permanently attached to the axle of the variable ca-capitor; no mechanical play can occur between scale and variable capacitor, and hence no inaccuracy of the frequency setting. The play in the gearing unit is noticable with manual control, however, because the resistance of the slide-clutch makes itself felt only when the teeth of the gears are engaged. This fact can be used to facilitate the final turning touch by rotating K1 slightly beyond the nominal setting and making the final adjustment within the easy zone.

The terminal jacks for the various specimens are at the center of the device below the cathode ray tube. This shall prevent annoyance from connecting cords during measurements.

A hinged adapter is arranged in front of the screen for addommodation of a transparent graticule plate graduated in level and frequency so that the result can be read directly. For photographic recording a lighting adapter is mounted. Its graticule can be illuminated by two lamps; their brightness can be continuously controlled with a variable resistor.

For this photographic recording the Siemens display camera B 952 with Palorid-Camera-Back can be used.

For pensiling the screen traces transparent graphic sheets are available (see Sect.IV "Accessories", p.12) which are fastened between graticule and apertured plate. These sheets (74x105 mm) are of Pergamin; at their rear they carry a corresponding graticule; their left edge is gummed for ease of pasting the sheets in books.

The removable light hood protects against the incidence of disturbing light.

The inside layout of the device is shown by the Figures 1 to 4 in the "Parts List, Fault Locating, Fault Eliminating" part.

Accessories, dimensions and weights

Description	Type S45034-...	Dimensions in ft./in.	Approx. weight in lb
Level Tracer			
Model -35/+23 dB (200-6000 Hz)	K211-B114	1'4 1/4"x1'1 1/4"x1'4 1/8"	59
Model -35/+23 dBm (200-4000 Hz)	K211-G214		

Accessories with each model:

Description	Type	B114	G214
tubes	C3m	10	10
tubes	E91 AA	2	2
cathode ray tube	DP 10-14	1	1
indicating lamp 12 v	Fg lp 62 b	1	1
fuses (as spares)		3 (2)	3 (2)
1 amp at 110 and 130 v	1 C DIN 41571		
0.5 amp at 220 and 240 v	0.5 C DIN 41571		
screen graticule dBm/Ω	S45034-B917-W5		1
Ω	S45034-B917-W6		1
dB/Ω	S45034-K211-W1	1	
Ω	S45034-K211-W2	1	
viewing shade	Rel mse 253 T 113	1	1

Optional (to be ordered separatly, if required)

Description	Type	B114	G214
Connecting cord	V42255-R6-J23 length 6'7"	3	3
expanded scale subassembly (with expanded screen graticule)	S45034-K247-A701	1	1
Display Camera	S45034-B952-B702	1	1
Transparent chartforms			
dB/Ω (200-6000 Hz)	S45034-K211-Z3	1	
Ω (200-6000 Hz)	S45034-K211-Z4	1	
dBm/Ω (200-4000 Hz)	S45034-K211-Z6		1
Ω (200-4000 Hz)	S45034-K211-Z7		1

I N S T R U C T I O N S F O R U S E

B I. PREPARATORY WORK

1. Loosen the locks and remove lid.

2. Find out the nominal mains voltage.
In case of 110-v service no change is needed on the device. With mains of 130, 220, or 240 v make an adjustment as follows:

a. 130 v: Remove the relocate fuse S9 on the panel and reinsert it in a way that the lettering "130" appears.

b. 220 or 240 v: Loosen the eight screws on panel and equipment frame and withdraw the chassis; remove on the power transformer Tr the links at the terminal points 1a-2a and 3a-4a and solder a new link between 2a-3a; reinsert the chassis.

On the panel replace the 1-amp fuse link by one rated for 0.5 amp. In 220-v operation the relocate fuse must be set to "110" and in 240-v operation to "130"; change the lettering "110" or "130" correspondingly to "220" or "240".

3. Check whether the supplied power plug (Leviton plug No. 637) fits the power outlet.

4. If the two-pole plug has to be replaced by a three-pole plug connect, as follows, the three wires of the power cord which become available after

removing the power plug (red: ground conductor, additionally marked by yellow ring with "⏚"; black and grey):

with non-polarized connectors the red wire to the protective ground terminal, and the grey and black wires to the current-carrying terminals;

with polarized connector systems in mains with phase and neutral the red wire to the protective ground terminal, grey wire to the neutral terminal, black wire to the "phase" terminal.

5. Activate and set the frequency skipping circuit (Figs. 2a and 2b):
The device must be disconnected from the mains.

a. Withdraw chassis from the casing for access to the cam switches (annexed Fig. 2 in the "Parts List, Fault Locating, etc." part).

b. Turn on switch S8: This causes skipping of the tone dialling frequency 2600 c/s. (The set leaves the factory with the frequency skipping circuit set to 2600 c/s.)

If a different frequency is to be skipped, the following points c to n must also be performed:

c. Operate the switches S1, S2, S3 to position " ▼ " and S4 to the position " ▼ III-VI".

d. Loosen the four nuts (3), (4) (with spanner 4.5 mm).

e. Set on the dial of the variable capacitor K1 the frequency that is to be skipped.

f. While holding the control K1, apply a screwdriver to the slot of the cam (1) and rotate the latter until the actuating spring is exactly at the center of the cam elevation.

g. Clamp the cam disk (1) in position by tightening the two nuts (3). (The nuts are identified by their position with respect to the flattened washer.)

h. Set the same frequency as formerly (e) on the second half of the scale.

i. Hold the control knob K1 once more and set simultaneously the cam disk (2) (as (1)).

k. Tighten the two nuts (4).

l. If the frequency to be skipped is very low, need may possibly arise for increasing the capacitance C29 to secure the required frequency step

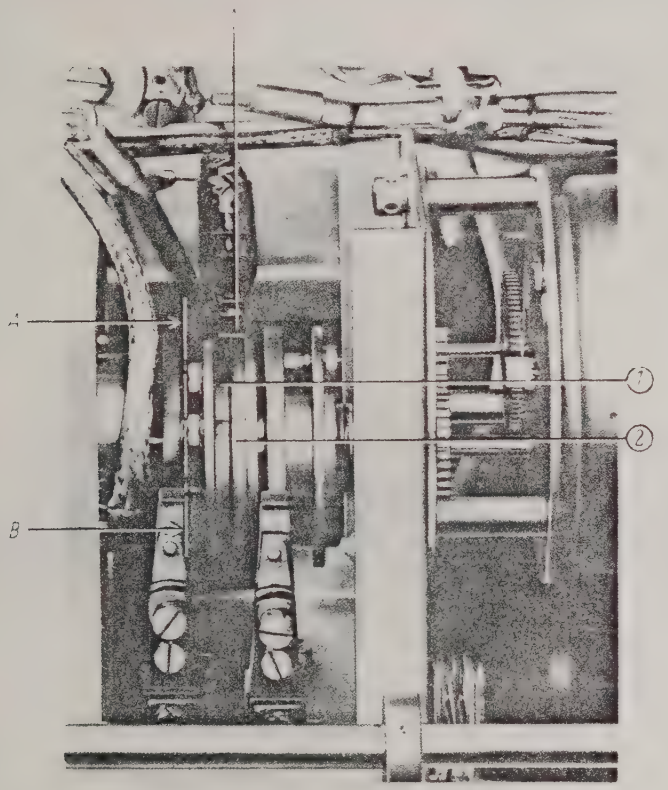


Fig. 2a Cam contacts for setting the frequency lockout

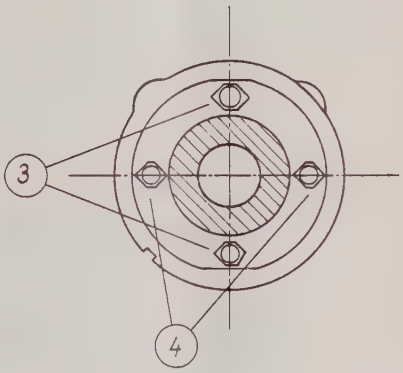


Fig. 2b Section A-B

(±200 c/s). For a check energize the device, interconnect the jacks OUTPUT and INPUT, and set S6 to MANUAL OPERATION. As the tuning control (K1) is rotated by hand, the luminous spot shows distinctly the frequency step.

m. Change the skip width as required by rotating the adjusting screw N on the corresponding spring set. See to it that the wiper of the cam switch does not bear against the valley of the cam disk.

n. Mount the chassis into the casing again.

6. If a two-pole power plug is employed connect the grounding terminal "⏚" on the front panel to an interference-free ground.

7. Connect the device to the mains and operate the power switch upward; the supervisory lamp becomes lighted.

8. With the potentiometers BRIGHTNESS and FOCUS adjust the luminous spot on the CRT screen in a way that it is well defined and just visible.

9. About 10 minutes after energization of the device the calibrating procedure can begin.

DO NOT ALLOW THE MEASURING SPOT ON THE CATHODE RAY TUBE TO REMAIN STATIONARY FOR EXTENDED PERIODS OF TIME. FAILURE TO OBSERVE THIS INSTRUCTION WILL RESULT IN PERMANENT DAMAGE TO THE CATHODE RAY TUBE PHOSPHOR. DECREASE THE INTENSITY CONTROL TO THE MINIMUM LEVEL OF BRIGHTNESS PROVIDING ADEQUATE RESOLUTION WHEN CONDUCTING MEASUREMENTS AND REDUCE THE INTENSITY CONTROL TO A MINIMUM DURING PERIODS WHEN THE INSTRUMENT IS NOT IN USE.

B II. Calibration

All calibration positions and controls are clearly marked in red on the front panel of the instrument, the dial of the tuning capacitor and the graticle. The symbol ▼ designates a calibration function or position.

1 Operate S1, S2, S3, S4 and S5 to the extreme lefthand positions.

2 Operate the drive motor switch to MOTOR OPERATION.

3 Adjust the control designated ▽I until the trace coincides with the ∞ line of the graticle designated ▽I.

4 Operate S4 to ▽II.

5 Adjust control designated ▽II until the trace coincides with the 0 db line of the graticle designated ▽II ▽III.

6 Operate S4 to ▽III ... VI.

7 Adjust the control designated ▽III until the trace coincides with the 0 db line of the graticle designated ▽II ▽III.

8 Operate the motor switch from MOTOR OPERATION to MANUAL OPERATION.

9 Rotate the tuning capacitor K 1 manually to 0.8 kc designated ▽IV on the frequency scale.

10 Depress the control designated ▽IV and rotate it until the measuring trace is at the bottom of the "V" shaped notch.

11 Rotate the tuning capacitor K 1 to 4 kc/6 kc designated ▽V on the frequency dial.

12 Rotate the control designated ▽V until the spot coincides with the 4 kc/6 kc line of graticle designated ▽V.

13 Rotate the tuning capacitor K 1 to 0.2 kc designated ▽VI on the frequency dial.

14 Rotate the control designated ▽VI until the spot coincides with the 0.2 kc line of the graticle designated ▽VI. (There is usually interaction between ▽V and ▽VI, and subsequent to the completion of ▽VI the accuracy of ▽V should be verified proceeding as in steps 11 and 12, and finally ▽VI should be repeated in accordance with steps 13 and 14 until the measuring spot may be ascertained to be in exact coincidence with the 0.2 kc and 4 kc lines of the graticle.

The instrument is now calibrated and ready for operation.

The calibration of the instrument should be verified according to steps 1 - 14 above after a warmup period of approx. one hour.

C. Transmission Measurement, General (see Fig. 8.9)

(Note If measurements are to be made at 900 ohms impedance using the K 211 c at one end only a measuring error of 1.8 db can result under some conditions. Refer to part of the attached section for an explanation and for instructions on how to correct the readings)

All steps under B above should be completed.

C I. Transmitting Section

1 Adjust S1 to transmit the desired level.

2 Adjust S2 to the input impedance of the facility under test.

3 Adjust S3 to LEVELING-IN-HORIZONTAL DEFLECTION FROM TRANSMITTER SECTION.

4 Connect the input of the facility under test to the OUTPUT Jacks of the Level Tracer.

5 Operate the motor switch to MOTOR OPERATION.

6 Where swept band operation is not desired, single frequencies may be transmitted by operating the motor switch to MANUAL OPERATION and selecting the frequency to be transmitted by means of the tuning capacitor K 1.

C II. Receiving Section

1 Adjust S3 to LEVELING-IN-HORIZONTAL DEFLECTION FROM TRANSMITTER SECTION.

2 Adjust S4 for a minimum sensitivity (+ 20 db).

3 Adjust S5 to bridge or match the output impedance of the facility under test as required.

4 The measured results will appear on the face of the cathode ray tube.

5 Adjust S4 for optimum display of the measured results.

6 The display of measured results will assume various forms depending on the nature of the source of measuring power.

These are summarized as follows:

a) For a swept band generator which traverses the band 0.2 to 4 kc/6 kc at a go and return rate not greater than 1 c/s a continous curve will be traced as a function of the frequency received. Lack of coincidence of the traces effected by the go and return sweeps of the transmitter indicates that the sweep rate exceeds the transient build-up time of the specimen under test.

b) For a swept band generator which traverses the frequency band 0.2 to 4 kc/6 kc as a function of increasing frequency only, a continuous curve will be traced from left to right as a function of the received frequency. Depending upon the mature of the swept band oscillator a display from right to left may or may not be present.

c) For a standard variable frequency oscillator which is swept manually over the frequency band 0.2 to 4kc/6 kc, the result will also appear as a continuous curve. The oscillator may also be set to single frequencies within this band in sequence and the measured values will appear as spots corresponding to the transmitted frequencies on the face of the cathode ray tube.

d) For a single frequency source of measuring power (milliwatt supply) the measured result will appear as a spot coinciding with the received frequency.

e) For a multi frequency generator the measured results will appear as a series of spots corresponding to the frequencies and levels received.

f) For a noise generator (WE 201), or for a series of tones transmitted simultaneously, no measurement is possible as the receiving section while frequency sensitive is not frequency selective. The presence of noise, crosstalk, excessive distortion, etc. is however, readily detected by modulation or deviation of the trace or spot.

7 The measured result in db is the algebraic sum of the position of S4 and the graticle reading. Where the transmitted level is known, the gain or loss of the facility is obtained by subtracting the transmitted level algebraicly from the algebraic sum of S4 and the graticle reading. (Where the transmitted level is 1-milliwatt or 0 dbm, the gain or loss of the facility is equal to algebraic sum of S4 and the graticle reading.)

8 If the transmission performance of the facility at a particular frequency must be known with greater accuracy, than that afforded by inspection or photography of the measuring trace (it being assumed that the transmitting section of the instrument is not in use), rotate the tuning capacitor K 1 to the frequency if interest, depress the button designated FREQUENCY MARKER and note carefully the graticle reading at the point of intersection between the measuring trace and the frequency marker. The exact frequency can be read at this point directly from the dial of the tuning capacitor K 1. The performance of the facility may be measured with a high degree of accuracy at any frequency within the range 0.2 to 4 kc/6 kc in this manner.

C III. Overall Transmission Measurement

1 All steps under B above should be completed.

2 Operate S1 to the transmitting level required for the specimen under test.

3 Operate S2 to the input impedance of the facility to be tested.

4 Operate S3 to LEVELING-IN-HORIZONTAL DEFLECTION FROM RECEIVER SECTION. (When the sending and receiving ends of the transmission facility under test are available at the same point, operate S3 to LEVELING-IN-HORIZONTAL DEFLECTION FROM TRANSMITTING SECTION.)

5 Operate S4 to + 20 db (the position of minimum sensitivity of the receiving section).

6 Operate S5 to bridge or match the output impedance of the facility under test.

7 Operate the motor switch to MOTOR OPERATION.

8 Connect the input of the facility under test to the OUTPUT jacks of the Level Tracer.

9 Connect the output of the facility under test to the INPUT jacks of the Level Tracer.

10 The transmission gain or loss of the facility under test will be displayed in the form of a continuous curve as s function of frequency on the face of the cathode ray tube.

11 Adjust S4 to provide the optimum display of the measuring results.

12 The gain or loss of the facility under test is obtained by subtracting the transmitted level algebraicly from the algebraic sum of S4 and the graticle reading.

Example:	Transmitting level	+ 5 db
	S4	-20 db
	Graticle indication	- 2 db

The transmission loss of the facility is
- 20 db - 2 db - (+ 5 db) = - 27 db

13 If the transmission performance of the facility at a particular frequency must be known with greater accuracy than that afforded by inspection or photography of the measuring trace, the motor switch may be operated to MANUAL OPERATION, the tuning condenser K 1 is then rotated to the frequency of interest, (1 kc or 2.3 kc etc.) and the exact value of the loss at this frequency determined in the same manner described under step 12.

D. Impedance Measurement

NOTE: ALL SWITCH POSITIONS AND JACKS ASSOCIATED WITH THE IMPEDANCE MEASUREMENT AND IMPEDANCE COMPARISON ARE DESIGNATED IN BLUE.

1 Complete all operations under section B above.

2 Set S1 to Z MEAS.

3 Set S2 to Z MEAS. RANGE X 2.

4 Set S3 to Z MEAS. X.

5 Set S4 to Z MEAS.

6 Set S5 to Z MEAS.

7 Operate the motor switch to MOTOR OPERATION.

8 Connect the specimen to be measured to the jack designated Z MEAS. X. The impedance of the specimen as a function of frequency will be displayed on the face of the cathode ray tube.

9 Adjust S2 MEAS. RANGE Z to the position affording the optimum display of the measurement results.

10 The value of the impedance Z in ohms is the product of the graticle indication and the multiplying factor of S2. The right-hand side of the standard graticle is calibrated in ohms from 50 to 800. A special graticle calibrated in 50 ohms steps from 50 to 800 ohms is provided for measurements of a serial nature.

11 Where the magnitude of the impedance under test exceeds 1600 ohms, the transmitted level may be reduced in 5 db steps by means of S1 or the sensitivity may be increased in 5 db steps by means of S4. Each 5 db step results in an additional multiplying factor of 1.78.

Example: Scale reading 600 ohms
S2 Z MEAS. x 2
S1 + 5
Z equals 600 x 2 x 1.78 = 2136

12 For those cases where the exact magnitude of the impedance must be known or where the frequency of an impedance peak or valley (impedance irregularity testing) must be known with greater accuracy than that normally afforded by inspection or photography of the measured trace, proceed as follows:

Operate the motor switch to MANUAL OPERATION, rotate the tuning condenser K 1 by hand and note the values of Z, where this is the quantity of interest, from the graticle, or the frequency values from the scale of the oscillator.

NOTE: THE LEVEL TRACER DISPLAYS THE MAGNITUDE OF THE IMPEDANCE R + jX, NOT MERELY THE RESISTIVE COMPONENT R.

E. Return Loss Measurement (see Fig. 10, 11, 12)

E I. Return Loss Measurement Using Internal Hybrid

1 Complete all operations under B above.

2 Operate S1 to RETURN LOSS.

3 Operate S2 to RETURN LOSS.

4 Operate S3 to RETURN LOSS.

5 Operate S4 to - 5 db.

6 Operate S5 to RETURN LOSS!

7 Operate the motor switch to MOTOR OPERATION.

8 Connect the line to the X-jack (if battery or ringing current is present on the line, it should be connected to the LINE jack which inserts a 2 micro-farad blocking capacitor in series with the hybrid).

9 Connect the balancing network, standard, compromise network, etc. to the N-jack.

10 The return loss of the line against the network or standard will be plotted as a function of frequency on the face of the cathode ray tube.

11 Adjust S4 for optimum display of the measured results.

12 The return loss is equal to the algebraic sum of the graticle reading and the setting of S4. The resultant sum is always expressed as a positive quantity. When the internal hybrid is used, the Level Tracer is direct reading in return loss inasmuch as the trans-hybrid loss of the internal hybrid is automatically corrected for by the RETURN LOSS settings of the various switches.

13 Adjustment of the balancing network, the line building-out condenser or the net building-out condenser will result in improved return loss under most circumstances. The results of these adjustments may be observed on successive sweeps and the optimum return loss characteristics secured in this manner.

14 Where the return loss at a particular frequency must be determined with greater accuracy than that normally afforded by inspection or photography of the measuring results, operate the motor switch to MANUAL OPERATION, rotate the tuning capacitor K 1 to the frequency of interest (e.g. 2300 c/s) and read the return loss directly as in steps 11 and 12 above.

E II. Return Loss Measurement Using External TEST or TRUNK HYBRID

1 Complete all operation under section B above.

2 Set S1 for a transmit level of 0 db.

3 Set S2 to match the transmitting impedance of the 4-wire side of the hybrid.

4 Set S3 to LEVELING-IN-HORIZONTAL DEFLECTION FROM TRANSMITTING SECTION.

5 Set S4 to 0 db.

6 Set S5 to match the receiving impedance of the 4-wire side of the hybrid.

7 Connect the TRANSMIT jack of the hybrid to the OUTPUT jack of the Level Tracer.

8 Connect the RECEIVER jack of the hybrid to the INPUT jack of the Level Tracer.

9 Short the tip and ring of the 2-wire side of the hybrid.

10 Operate the motor switch to MOTOR OPERATION.

11 The trans-hybrid loss of the hybrid will be displayed as a function of frequency on the face of the cathode ray tube.

12 Adjust S4 for optimum display of the measured results. The trans-hybrid loss is found by subtracting algebraicly the setting of S1 from the algebraic sum of the setting of S4 and the graticle reading. If the trans-hybrid loss does not vary significantly as a function of frequency across the speech band and if its magnitude lies in the range from 5 to 10 db, it will generally be possible to achieve a zero loss measuring condition by increasing the transmit level to + 5 by means of S1 and adjusting ▽III until the trans-hybrid loss coincides with the 0 line of the graticle. In the event that this quantity is greater than the range of adjustment afforded by ▽III a second alternative is afforded by increasing the transmit level to + 10 and reducing the level by ▽III until the loss coincides with the 0 line of the graticle. Where this expedient is possible no correction for trans-hybrid loss must be made. Where it is not possible the trans-hybrid loss must be deducted from all measured results.

13 Remove the short from the tip and ring of the 2-wire side of the hybrid.

14 Connect the line to be tested to the 2-wire side of the hybrid.

15 The return loss will be displayed as a function of frequency on the face of the cathode ray tube.

16 Adjust S4 for optimum display of the return loss characteristics.

17 The return loss in db is found by subtracting algebraicly the algebraic sum of the trans-hybrid loss and S1 from the algebraic sum of S4 and the graticle reading, if the trans-hybrid loss has not been compensated for as in step 12 above. This result is always expressed as a positive quantity.

18 If the return loss at a given frequency must be known with greater accuracy than that afforded by inspection or photography of the measured results, operate the motor switch to MANUAL OPERATION, rotate the tuning capacitor X1 to the frequency of interest and determine the return loss in the same manner as described under Section E I. step 14 above. If the trans-hybrid loss of the external hybrid varies seriously as a function of frequency, this fact must be taken into account on arriving at an accurate determination of the value of the return loss.

19 Adjust the variable elements of the balancing network, etc. to obtain the maximum return loss.

F. Comparing Level Measurement

1. Preparation and calibration according to Sect. B I and B II.

2. Operate S2 to position "$Z_i \sim 0$ for Z = 600 Ω" or "$Z_i \sim 0$ for Z = 900 Ω". If matching is required, build out the internal impedance of the transmitting section separately for the specimen X and the reference standard N to their impedance values (Fig. 2c)

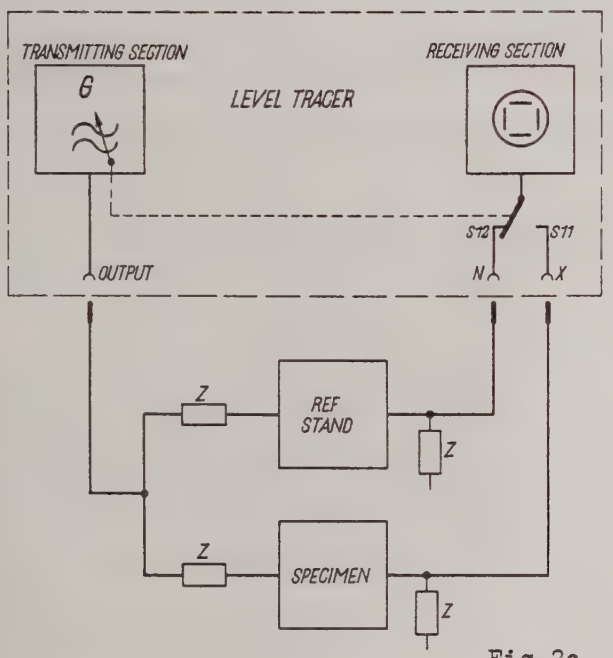


Fig.2c Comparing level measurement

3. Set S1 to the required transmitting level. The transmitting level across the specimen is 6 db below the setting of S1, if the source impedance had been built out externally.

4. Bridge the input of the specimen X and the reference standard N across the jacks OUTPUT.

5. Operate S6 to MOTOR OPERATION.

6. Terminate the specimen into a parallel resistor.

7. Terminate the reference standard into a parallel resistor.

8. Operate S3 to the position LEVELING X, N.

9. Connect the output of the specimen to jack "X".

10. Connect the output of the reference standard to jack "N".

11. Rotate S5, corresponding to the position of S2, to "> 25 kΩ for Z = 600 Ω" or "> 25 kΩ for Z = 900 Ω".

12. Set S4 in a way that both measuring traces are well visible on the CRT screen. The annexed Fig.6 shows a typical curve.

13. Measurements result: Each of the two curves on the CRT screen shows the absolute power level if any of the settings Z = 600 or Z = 900 is chosen. The measurement value is the algebraic sum of scale value and value set on S4 in dbm. The difference between specimen and reference standard can be read directly on the scale in decibel.

14. If the measurement curves are to be recorded and duplicated, proceed according to Sect. IV.

G. Comparing Impedance Measurement

All switch positions for impedance measurements are lettered in blue.

1. Preparation and calibration according to Sect. B I and B II.

2. Operate S3 to the position Z MEAS X, $\frac{X+N}{2}$ and S5 to the position ∇/Z-MEAS and S2 to the multiplier Zx2.

3. Operate S1 to S4 to the position Z-MEAS. The voltage across the specimen is then approx. 0 db for the maximum measurable impedance. If a lower level is required (e.g. for measuring an amplifier input), move S1 and S4 in opposite directions. The position Z MEAS corresponds on S1 to the position + 10 db and on S4 to the position 0 db. If, for instance, the level across the specimen must not exceed - 10 db, operate

S1 to 0 db
S4 to - 20 db.

4. Connect the specimen X to the jacks "X" and the reference standard N to the jack "N" on the level tracer.

5. Operate S6 to MOTOR OPERATION.

6. With S2 vary the impedance range Z in a way that the measuring traces are well visible on the CRT screen. The annexed Fig. 17 shows a typical curve.

7. If even the highest impedance range should not suffice, reduce the transmitting level at S4 by 5 db, i.e., rotate the switch from the position Z-MEAS to the position + 5 db. This increases the impedance range by the multiplier 1.8, corresponding to a highest measurable impedance of 2900 Ω.

8. Measurement result: The two curves coincide only, if X and N are equal by magnitude and phase. During the go sweep the trace represents the impedance X, during the return sweep it represents as a function of frequency half the phasor sum of specimen and reference standard $(\frac{X+N}{2})$.

9. For recording and duplicating the screen traces, proceed according to Sect. IV.

H. Adjustment of Impedance Compensators

H I. Test Equipment

The following equipment is required:

- Siemens K211 or Rel 3 K 211 b, g or g1a Level Tracer
- Siemens B51 or Rel 3 B 51 Decade Capacitance or Western Electric 7A Capacitance Box (one is required at the toll switching office and another is required in the class 5 office.)
- 115 type Precision Network
- Compromise Network 900 ohms + 2.14 - 2.18 MF

H II. Test Procedure

When a negative impedance repeater is used in a toll switching office or in an intermediate office, the repeater must be in the trunk, functioning at its specified gain before proceeding with the test.

Method:

Step 1: Select a random sample of the trunks using impedance compensators and working in the same trunk cable loading compliment. Take out of service the trunks to be tested.

Step 2: From Table 1, Fig. 14 select the proper network for use in the class 5 office. Strap the network terminals in accordance with Table 1, Fig. 14

Step 3: At the class 5 office MDF open the trunk under test. Connect terminale 1 and 2 of the 115 type network to the outside cable conductors at the MDF. Connect the decade capacitance across the building-out capacitor in the 115 type network and set the dials of the decade capacitance to build the network out to equal the approximate full section value.

Step 4: At the toll switching office open the trunk at the impedance compensator terminals B1 and B2.

Step 5: Connect the Jack X of the K 211 Level Tracer to the B1, B2 terminale of the impedance compensators. Connect the compromise network (900 ohms + 2 MF) to the N-Jack of the Level Tracer. The switches on the Level Tracer are operated as follows:

S1 to RETURN LOSS
S2 to RETURN LOSS
S3 to RETURN LOSS
S4 to - 5 db
S5 to RETURN LOSS
Motor switch to MOTOR OPERATION

NOTE: K 211 requires an AC power supply of 110 V.

Step 6: Connect the decade capacitance to terminals A and C of the impedance compensator "A" capacitor.

Step 7: When negative impedance repeaters with disablers are used, block the enabler relay in its operated position.

Step 8: Adjust the decade capacitance connected to the impedance compensator until maximum return loss is indicated on the Level Tracer. Adjust S4 for optimum display.

Step 9: Adjust the decade capacitance at the class 5 office until maximum return loss is indicated on the Level Tracer at the toll switching office.

Step 10: Repeat steps 8 and 9 until neither decade capacitor can be changed without decreasing the return loss.

Step 11: Record the dial settings (in MF) of the decade capacitance box at the toll switching office.

Step 12: Remove all test connections, unblock the relay of step 7 and reconnect all wires.

Step 13: Repeat the above steps on all trunks selected for test.

Step 14: Add the capacitance values obtained in step 11 for all trunks samples and divide the total by the number of trunks tested. The resulting value is the building-out capacitance which should be strapped into the "A" capacitors of the impedance compensators associated with all trunks represented by the sample of step 1.

NOTE: Due to the great speed with which these measurements may be made utilizing the Level Tracer, the optimum capacitance value of each trunk may be determined and that value strapped into the impedance compensator rather than proceeding on the sampling basis of steps 1 and 14.

Step 15: Restore all trunks to service.

I. Structural Return Loss Measurements on Loaded Cable

I I. Test Equipment

The following equipment is required:

- Siemens K211 or Rel 3 K 211 b or g Level Tracer
- Siemens B51 or Rel 3 B 51 Decade Capacitance or Western Electric 7A Decade Capacitance (one is required at the near end office and another at the far end office.)
- 115 type Precision Network see Table 1, Fig.13 for types (one is required at the near end office and another at the far end office).

I II. Test Procedure

Step 1: From Table 1, Fig.13 select the proper network for use on the type of facility being tested. Strap the network terminals in accordance with Table 1 for the type of cable being measured.

Step 2: At the far end office MDF connect terminals 1 and 2 of the 115 type network to the outside cable conductors at the MDF. Connect the decade capacitance box across the building-out capacitor and build out the precision network to the approximate full section value.

Step 3: At the near end office connect the X-Jack of the Level Tracer to the outside cable conductors at the MDF.

Step 4: Connect the N-Jack of the Level Tracer to terminals 1 and 2 of the 115 type network.

Step 5: Connect the decade capacitance box across the building-out capacitor of the precision network.

Step 6: Operate the switches of the Level Tracer as follows:

S1 to Z MEAS.
S2 to Z MEAS. RANGE X 2
S3 to Z MEAS. X
S4 to Z MEAS.
S5 to Z MEAS.
Motor switch to MOTOR OPERATION

Step 7: Observe the measured curve for the presence of loading irregularities or line faults.

Step 8: If step 7 reveals the presence of line faults or irregularities, tag the pair and report it to the proper authorities.

Step 9: If no defects are present, proceed as follows:

Set the controls on the Level Tracer as follows:

S1 to RETURN LOSS
S2 to RETURN LOSS
S3 to RETURN LOSS
S4 to - 5 db
S5 to RETURN LOSS
Motor switch to MOTOR OPERATION

Step 10: Adjust the decade capacitance box at the near end location until maximum return loss is indicated on the Level Tracer. (Adjust S4 for optimum display.)

Step 11: Adjust the decade capacitance at the far end office until maximum return loss is indicated on the Level Tracer at the near end.

Step 12: Repeat steps 10 and 11 until neither decade capacitor can be changed without decreasing the return loss.

Step 13: Record the dial settings (in MF) of the decade capacitance at the far end office for future reference.

Step 14: Observe the measured return loss. The value should exceed 27 db across the speech band for all points below 0.9 f_o.

NOTE: If a value return loss at a single frequency or frequencies, e.g. 1000, 2300 c/s is required operate the motor switch of the Level Tracer to MANUAL OPERATION, adjust the tuning capacitor K to the frequency of interest and record the measured value of the return loss.

Step 15: Remove all test connections.

Step 16: Repeat steps 1 to 15 on all other pairs in the cable.

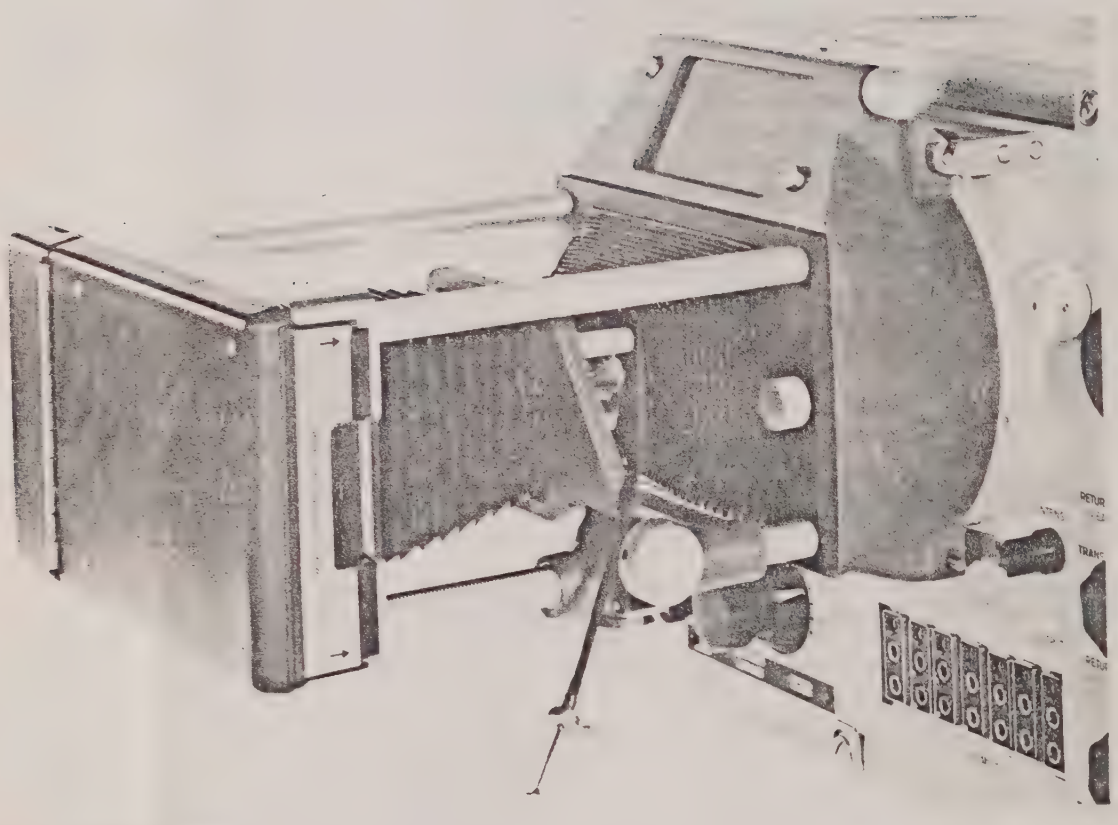


Fig.3 Level Tracer
with Siemens display-camera B 952

IV. PREPARATION OF MEASUREMENT RECORDS

A. Preparatory Work for Photographing Screen Traces

In using the Siemens display-camera B 952 see instruction for use of this camera. Also any other display-camera with suitable adapter can be used.

B. Penciling the Measuring Curves on Graphic Sheets

1. Swing up the graticule frame.
2. Select the corresponding graphic sheet according to the Sect. IV, "Accessories", p. 12.
3. Grip with the hand through the frame and hold the graphic sheet in position, after placing it accurately onto the graticule.
4. Push frame back in position so that the graphic sheet is firmly held.
5. Draw the screen trace with a soft pencil on the graphic sheet.

Correction factors for Transmission Measurements for type K211-B114

Since most operating procedures are the same for both types of sets, only one set of instructions is given. Where it is necessary to refer to the two sets separately, the information pertaining to the 4 kc model (-G214) is given first followed by the information pertaining to the 6 kc model (-B114) identified by slanted lines. For example, in discussing the upper frequency limit for the Level Tracer, the text would read "The upper frequency limit for the Level Tracer is 4 kc/6 kc/."

The 211 b and 211 g model Level Tracers can be switched to operate at both 600 ohms and 900 ohms impedance. However, the 211 b model does not send a true milliwatt at 900 ohms and it does not read "0" dbm when it receives a true milliwatt at 900 ohms. This will result in measuring errors of 1.8 db when the 211 b model is used at one end of a 900 ohm circuit and either the 211 g or another set is used at the order end of the circuit. The error results because of the difference between the voltages corresponding with 1-milliwatt at 600 ohms and 1-milliwatt at 900 ohms. As seen from the formula for power (P), the voltage (E) is different for 1-milliwatt at 600 ohms than it is for 1-milliwatt at 900 ohms:

$$P = \frac{E^2}{Z} \quad ; \qquad E = PZ$$

$Z = 600$, $P = 1\text{-milliwatt}$ $\Big)$ $\quad E = (1X10^{-3})\ (600) = 0.775$ volts

$Z = 900$, $P = 1\text{-milliwatt}$ $\Big)$ $\quad E = (1X10^{-3})\ (900) = 0.949$ volts

As seen from the formula, the output voltage of an oscillator must be 0.949 volts if it is to send a true milliwatt into a circuit of 900 ohms impedance. However, the 211 b model does not have an output voltage of 0.949 volts when it is operated at 900 ohms impedance. The output voltage remains at 0.775 volts for both 600 ohms and 900 ohms impedance. If the

211 b set is used to send to a 211 g or other standard measuring set the circuit will read 1.8 db "long" or too much loss. Conversely, the 211 b Level Tracer indicates 0 dbm (1-milliwatt) whenever the received signal has a voltage of 0.775 volts, regardless of impedance. Thus when the 211 b receives a true milliwatt at 900 ohms (0.949 volts) it indicates a received level of + 1.8 dbm. That is, if the 211 b is used at the receiving end of measurements over 900 ohm circuits, it will indicate that the circuit is 1.8 db "shorter" (less loss) than it actually is.

It can be seen that the errors are selfcancelling, so that there is no difficulty if a 211 b set is located at both ends of the circuit. Nor is there any difficulty when the circuit has 600 ohms impedance, since 0.775 volts corresponds with 1-milliwatt at 600 ohms. The only difficulty arises where the 211 b is located at one end of a 900 ohms circuit with a 211 g or other "true milliwatt" device at the opposite end. As discussed above, the correction factors for measurements at 900 ohms are:

211 b at sending end only:	Subtract 1.8 db from the measured loss of the circuit
211 b at receiving end only:	Add. 1.8 db to the measured loss of the circuit

The 211 g model sends a true milliwatt at both 600 ohms and 900 ohms impedance. The output voltage is changed as impedance is changed. Also, the 211 g reads "0 dbm" when it measures 0.775 volts at 600 ohms or 0.949 volts at 900 ohms. Thus the 211 g model Level Tracer can be used with standard 900 ohm test lines and measuring sets without need of correction factors.

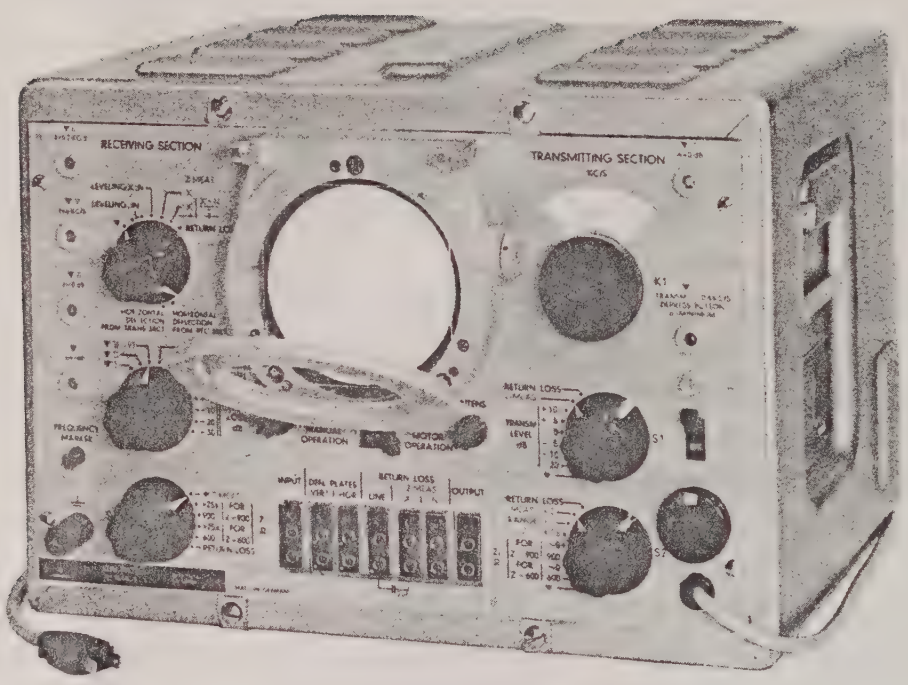


Fig. 4a
Level Tracer

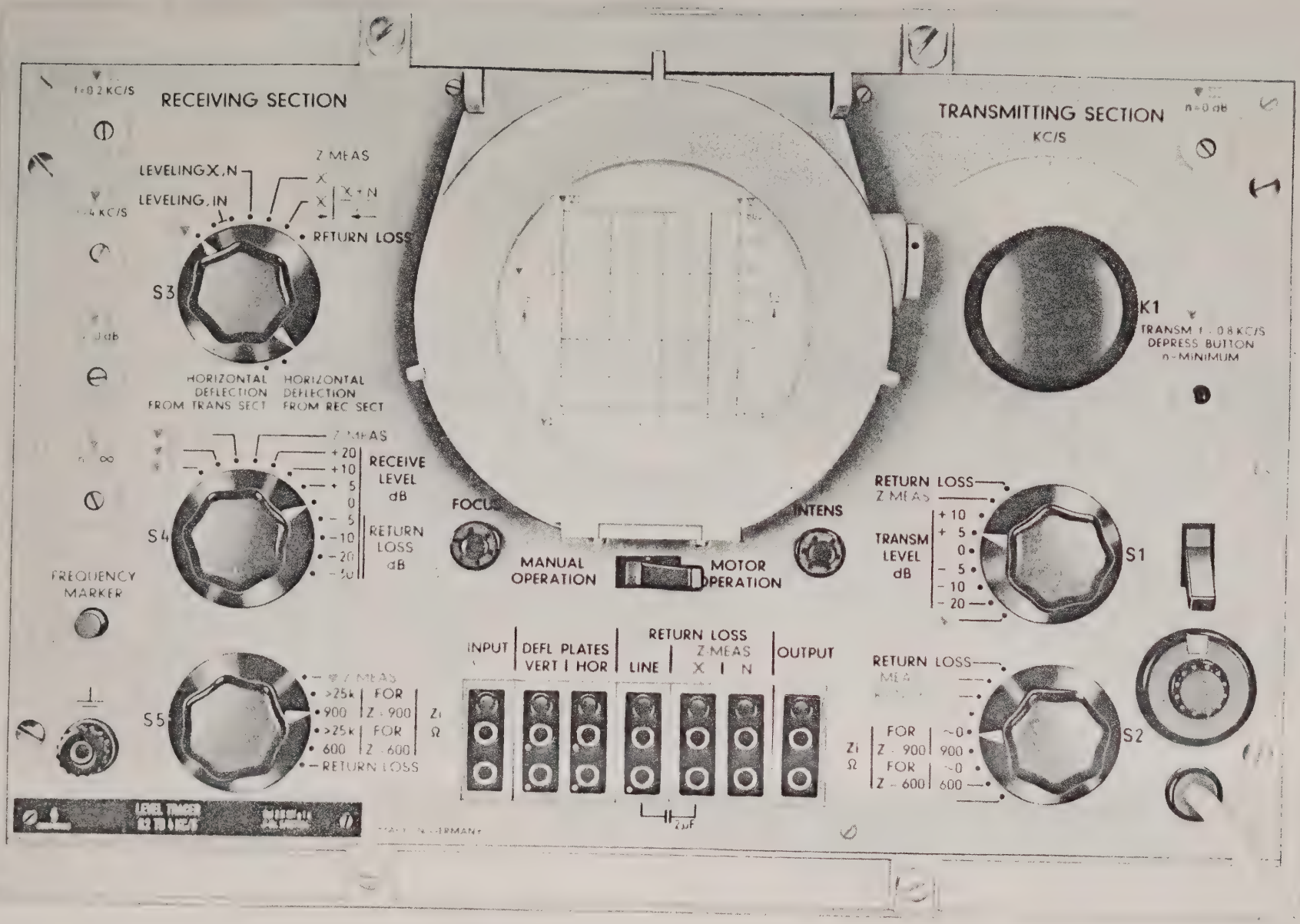
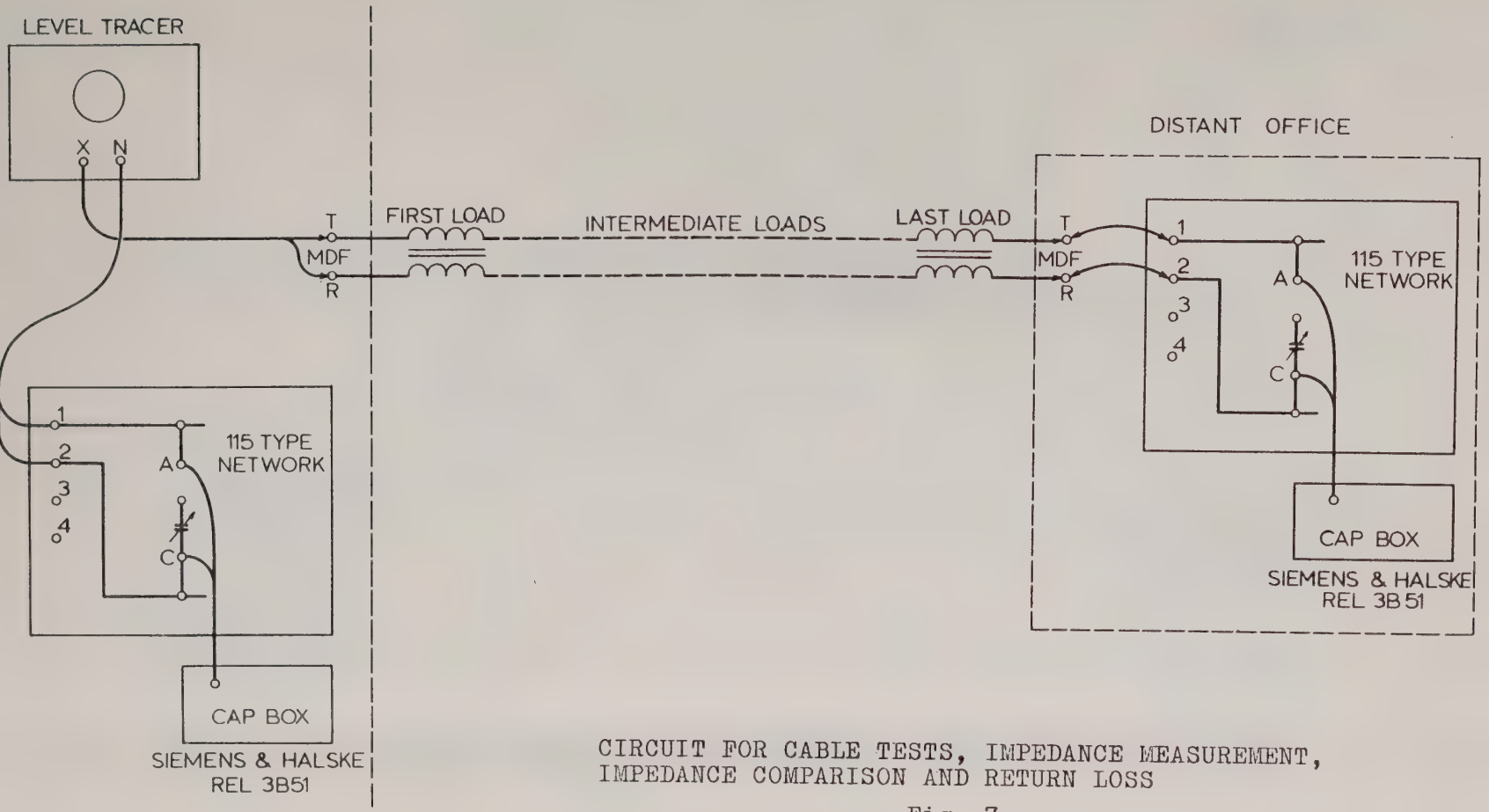
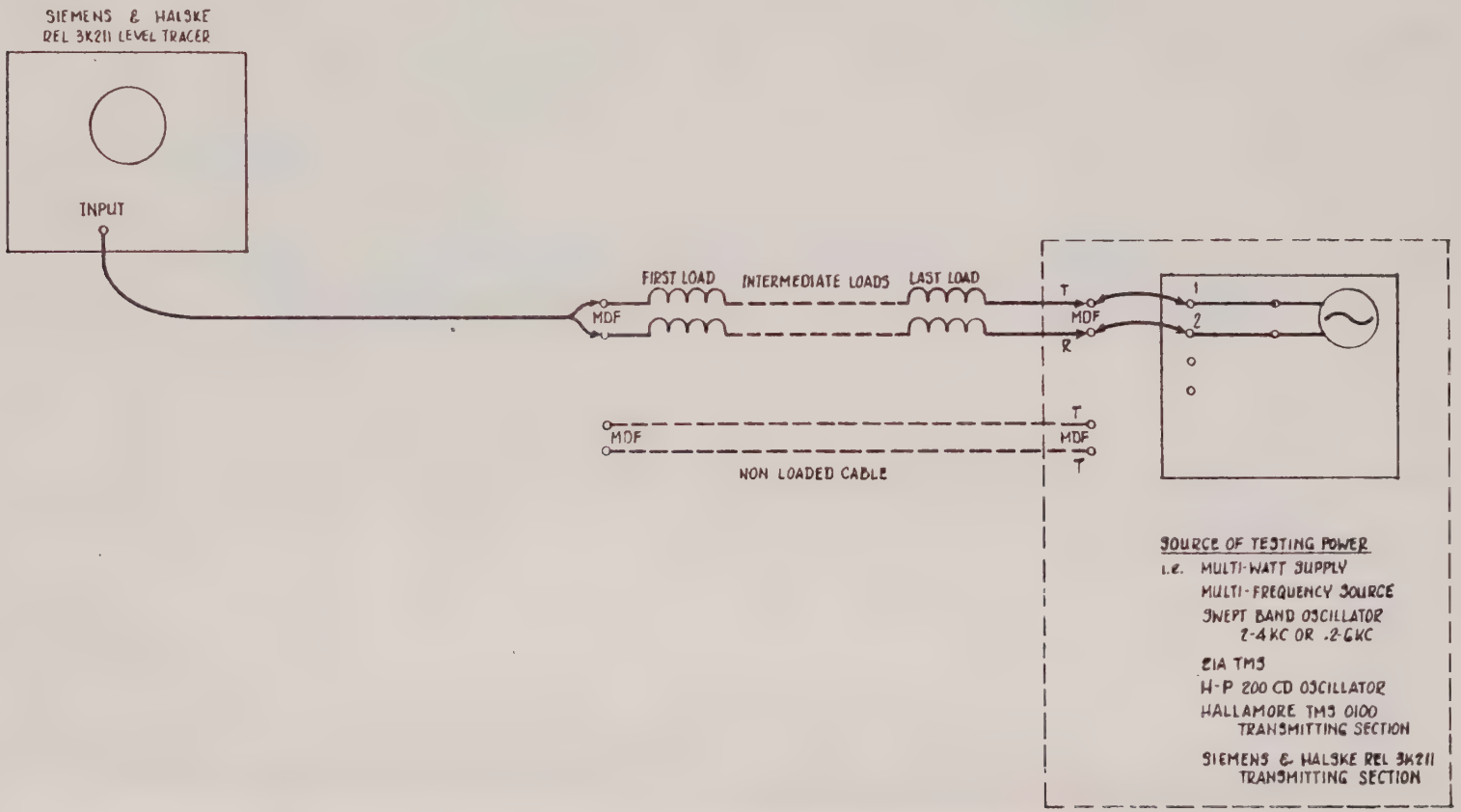


Fig. 5
Level Tracer K 211



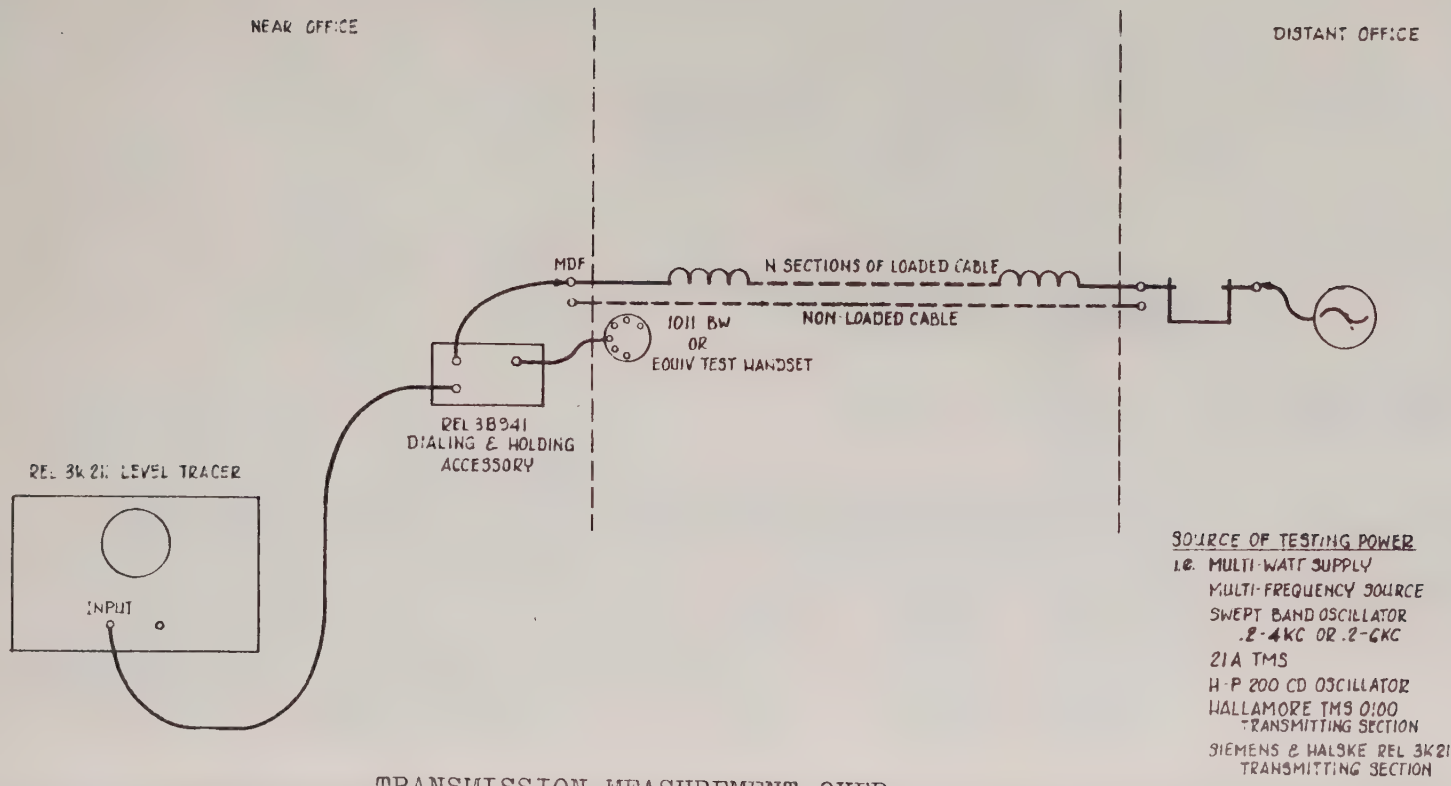
CIRCUIT FOR CABLE TESTS, IMPEDANCE MEASUREMENT, IMPEDANCE COMPARISON AND RETURN LOSS

Fig. 7



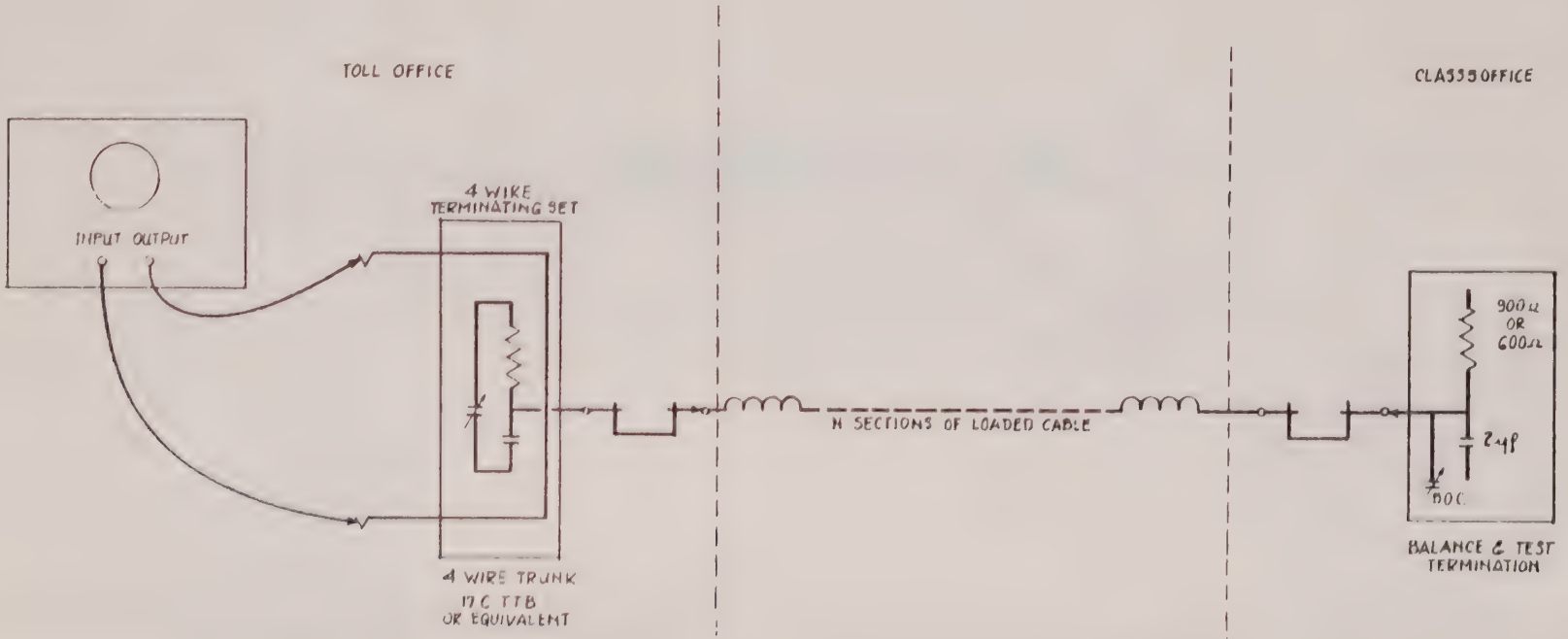
TRANSMISSION MEASUREMENT BETWEEN
MDF'S OF NEAR AND DISTANT OFFICES

Fig. 8



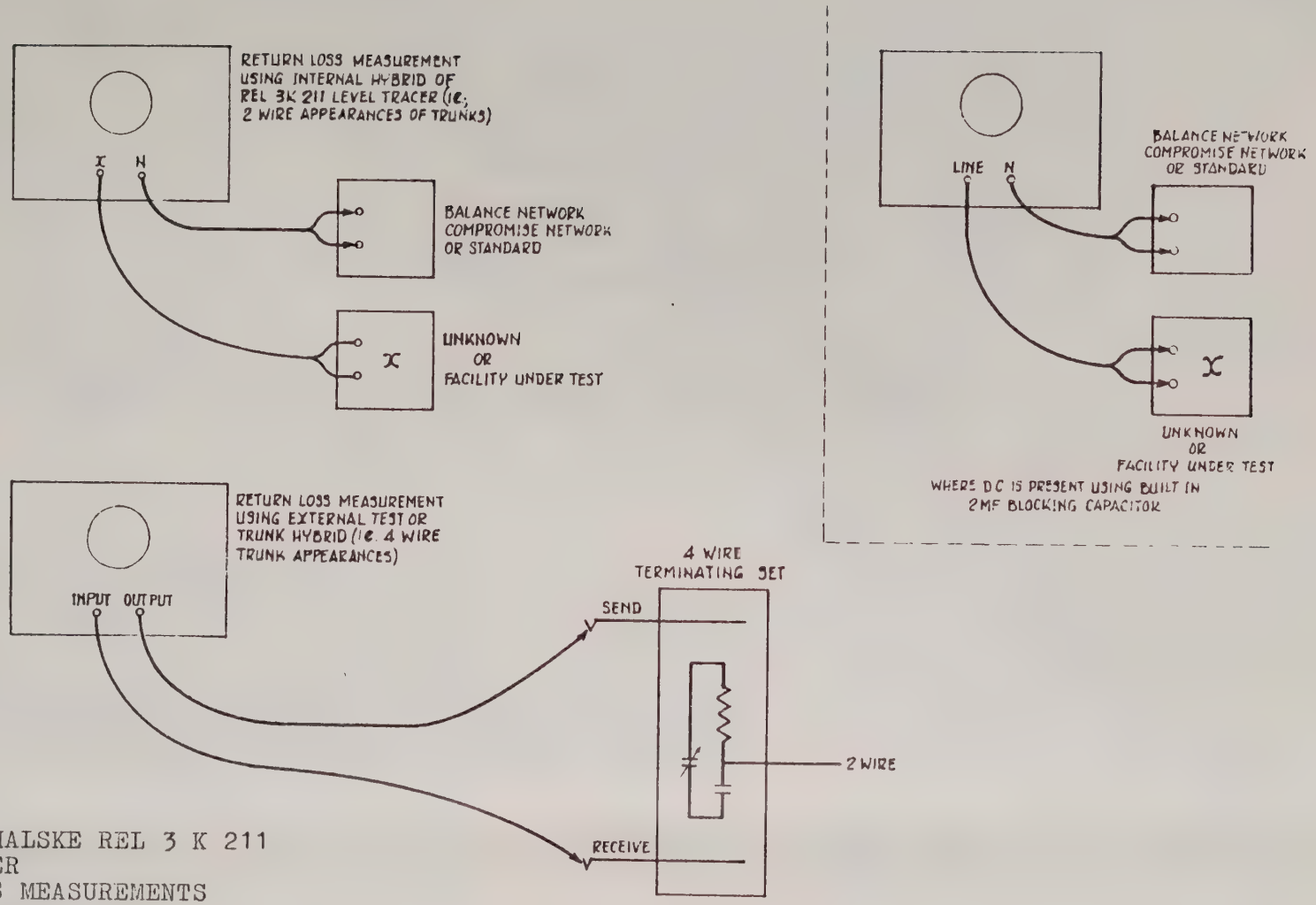
TRANSMISSION MEASUREMENT OVER
DIALED CONNECTION TO DISTANT
OFFICE I-MW TEST LINE

Fig. 9



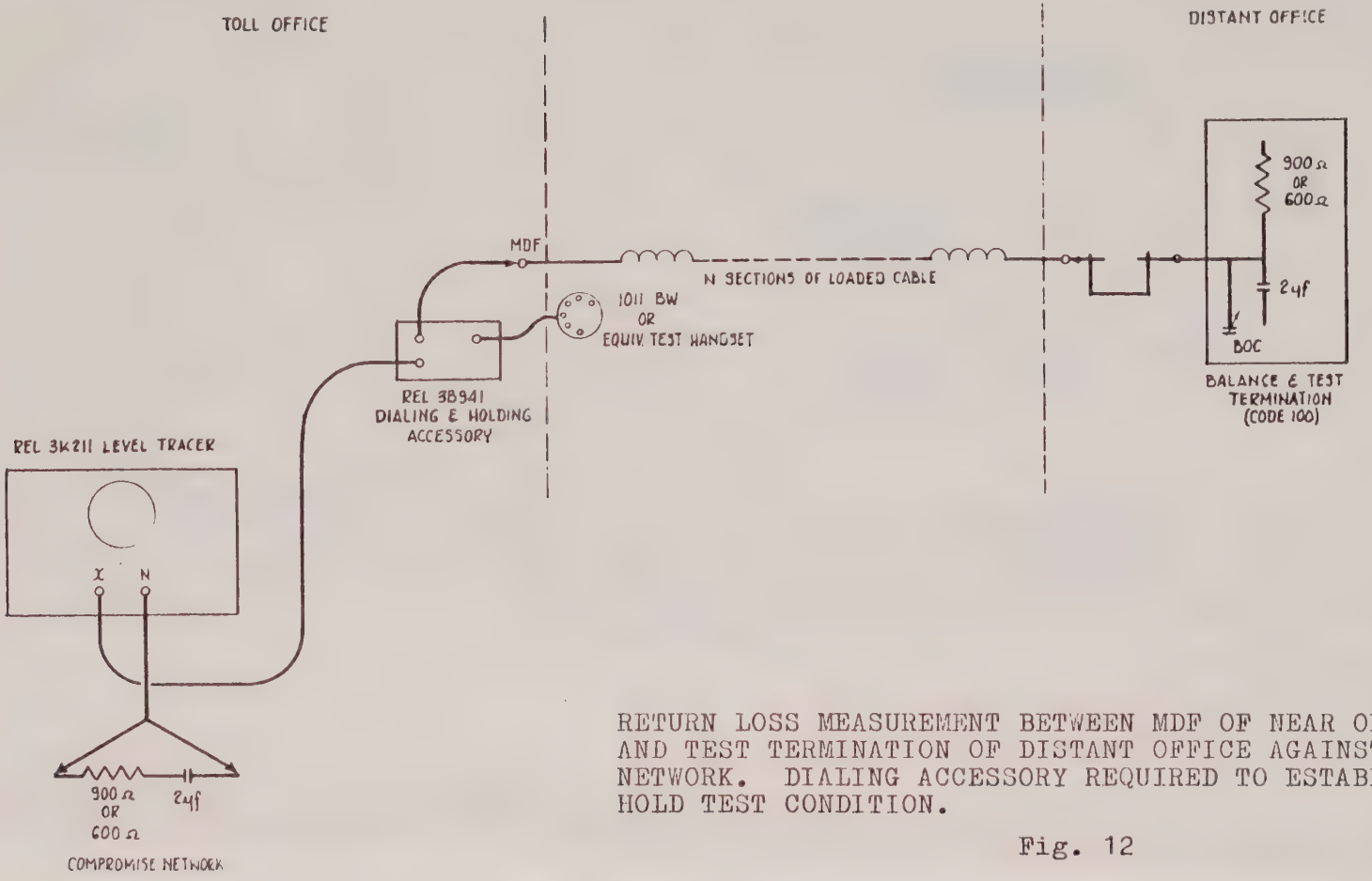
RETURN LOSS MEASUREMENT BETWEEN
4 WIRE TEST POINT OF TOLL OFFICE
AND BAL. AND TEST TERMINATION OF
DISTANT CLASS 5 OFFICE

Fig. 10



SIEMENS & HALSKE REL 3 K 211
LEVEL TRACER
RETURN LOSS MEASUREMENTS
TYPICAL CONNECTIONS

Fig. 11

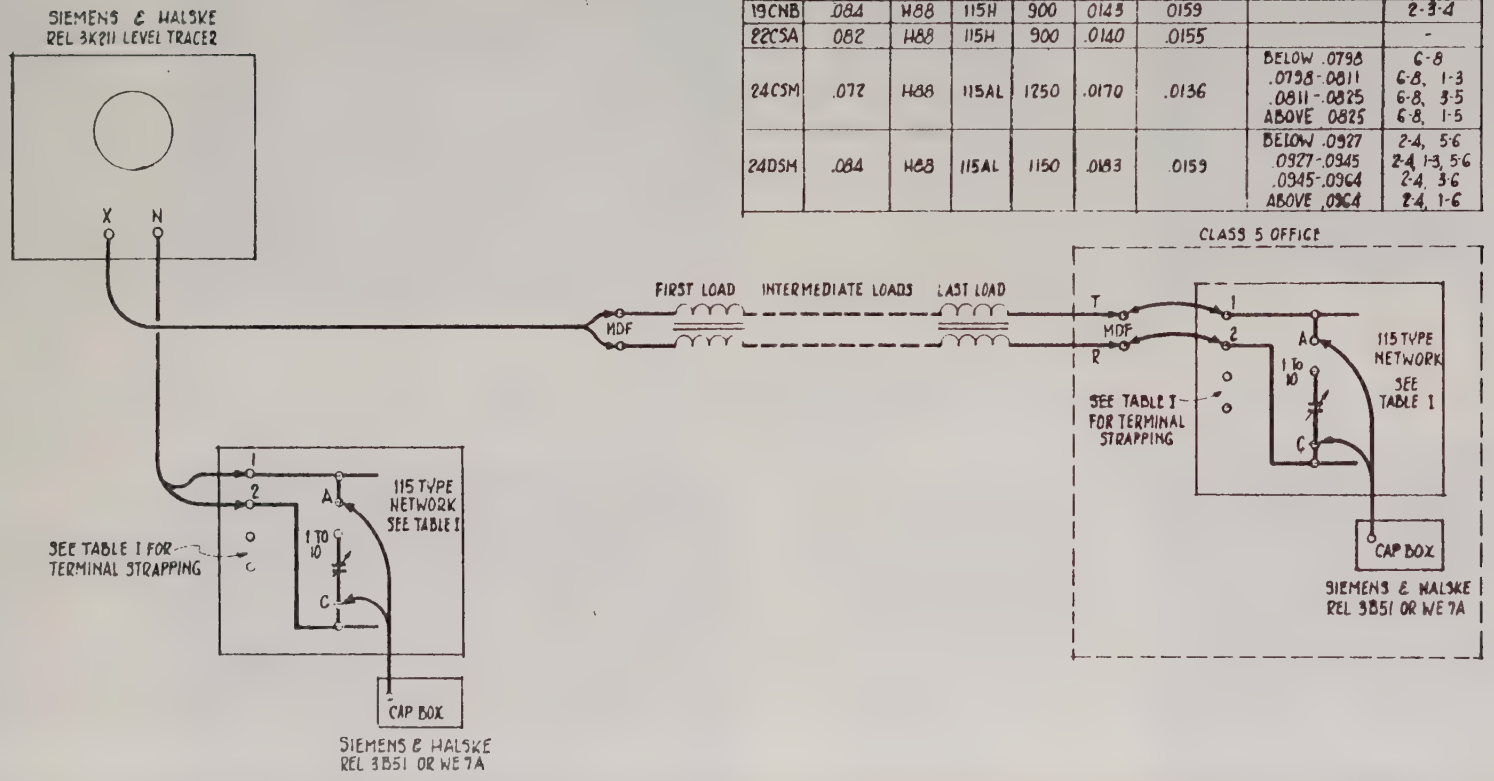


RETURN LOSS MEASUREMENT BETWEEN MDF OF NEAR OFFICE AND TEST TERMINATION OF DISTANT OFFICE AGAINST COMPROMISE NETWORK. DIALING ACCESSORY REQUIRED TO ESTABLISH AND HOLD TEST CONDITION.

Fig. 12

TABLE I

LINE BALANCING NETWORKS								
CABLE			NETWORK					
TYPE	NOMINAL CAP PER MILE (MF)	LOADING SYSTEM	TYPE	BASIC END SECTION FEET	BASIC END SECTION MF	BUILD-OUT CAPACITANCE TO ADD PER 1000 FT. (MF)	NETWORK TERMINAL STRAPPING: CAP PER AVERAGE LOAD SECTION(MF)	NETWORK TERMINAL STRAPPING: STRAP TERMINALS
19CNB	.084	H88	115H	900	.0143	.0159		2-3-4
22CSA	.082	H88	115H	900	.0140	.0155		-
24CSM	.077	H88	115AL	1250	.0170	.0136	BELOW .0798 .0798-.0811 .0811-.0825 ABOVE .0825	6-8 6-8, 1-3 6-8, 3-5 6-8, 1-5
24DSM	.084	H88	115AL	1150	.0183	.0159	BELOW .0927 .0927-.0945 .0945-.0964 ABOVE .0964	2-4, 5-6 2-4, 1-3, 5-6 2-4, 3-6 2-4, 1-6

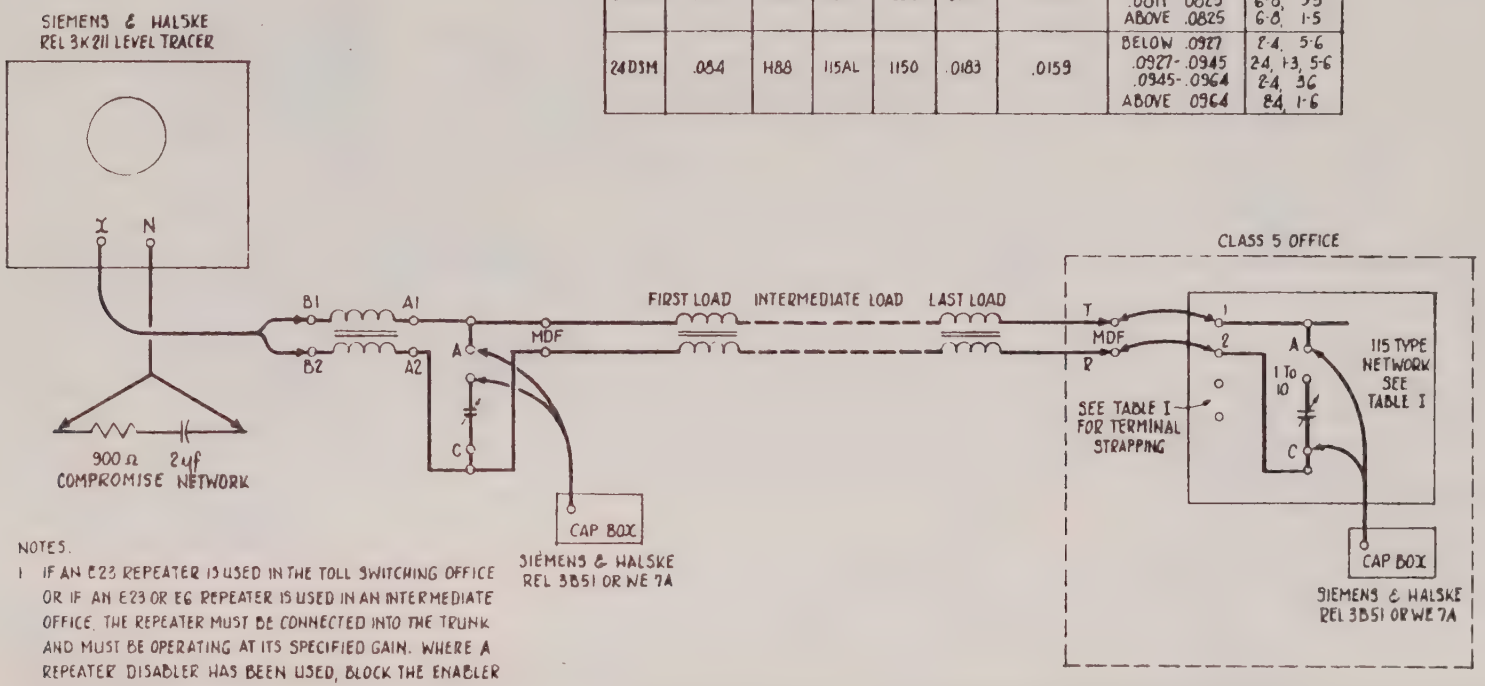


STRUCTURAL RETURN LOSS MEASUREMENTS
ON LOADED CABLE

Fig. 13

TABLE I

LINE BALANCING NETWORK								
CABLE			NETWORK					
TYPE	NOMINAL CAP PER MILE (MF)	LOADING SYSTEM	TYPE	BASIC END SECTION FEET	BASIC END SECTION MF	BUILD-OUT CAPACITANCE TO ADD PER 1000 FT (MF)	NETWORK TERMINAL STRAPPING: CAP PER AVERAGE LOAD SECTION(MF)	NETWORK TERMINAL STRAPPING: STRAP TERMINALS
19CNB	.084	H88	115H	900	0143	.0159		2-3-4
22CSA	.082	H88	115H	900	.0140	.0155		
24C3M	.072	H88	115AL	1250	.0170	.0136	BELOW .0798 .0798 - .0811 .0811 - .0825 ABOVE .0825	6-8 6-8, 1-3 6-8, 3-5 6-8, 1-5
24D3M	.084	H88	115AL	1150	.0183	.0159	BELOW .0927 .0927 - .0945 .0945 - .0964 ABOVE .0964	2-4, 5-6 2-4, 1-3, 5-6 2-4, 3-6 2-4, 1-6



NOTES.

1. IF AN E23 REPEATER IS USED IN THE TOLL SWITCHING OFFICE OR IF AN E23 OR E6 REPEATER IS USED IN AN INTERMEDIATE OFFICE, THE REPEATER MUST BE CONNECTED INTO THE TRUNK AND MUST BE OPERATING AT ITS SPECIFIED GAIN. WHERE A REPEATER DISABLER HAS BEEN USED, BLOCK THE ENABLER RELAY OPERATED.
2. AT THE TOLL SWITCHING OFFICE, DISCONNECT THE OFFICE CABLE WIRES (AND THE LOW FREQUENCY IMPEDANCE CORRECTOR, IF USED) FROM TERMINALS B1 AND B2 OF THE IMPEDANCE COMPENSATOR 638 LOADING COIL (A).

ADJUSTMENT OF IMPEDANCE COMPENSATORS

Fig. 14

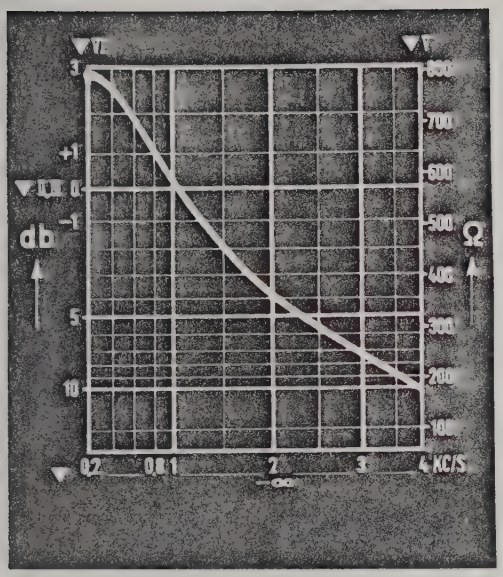


Fig. 15

Frequency response of a line repeater section not adjusted in the strapping network

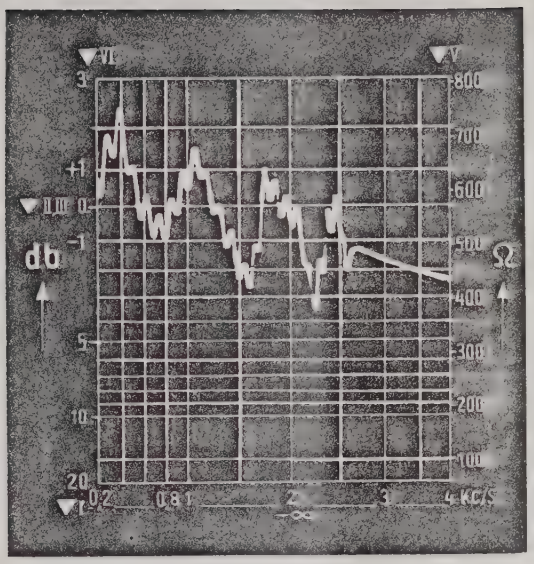


Fig. 16

Impedance of a terminated line. The fine structure (ripple) is caused by a mismatch at the far end of the line. The four approx. sinusoidal waveshapes show a mismatch at a point where a transfer from 4 wire to 2 wire operation is effected. Distance approx. 1/7 of the total length.

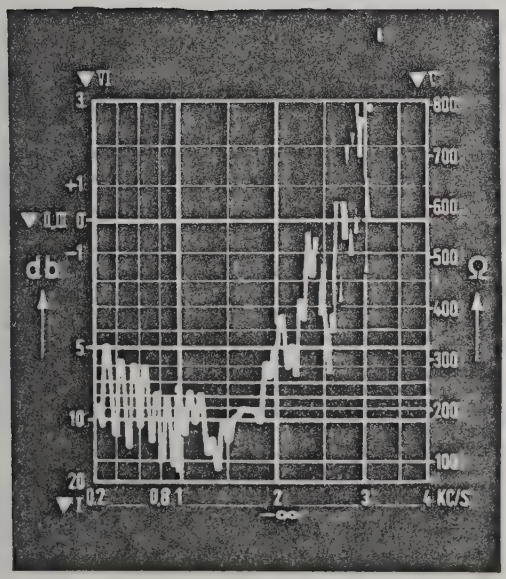


Fig. 19

Return loss of a line against correctly adjusted balancing network. Attenuator set to -20 db

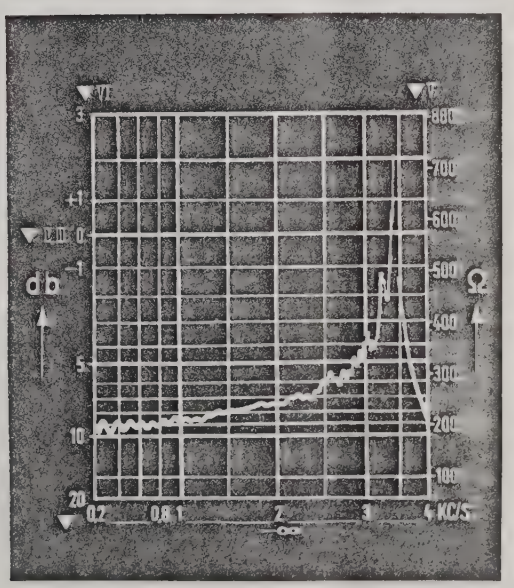


Fig. 20

Typical impedance versus frequency trace of 19ga high capacity cable, 488 loading. Cable correctly loaded and terminated,
impedance scale appr. x7

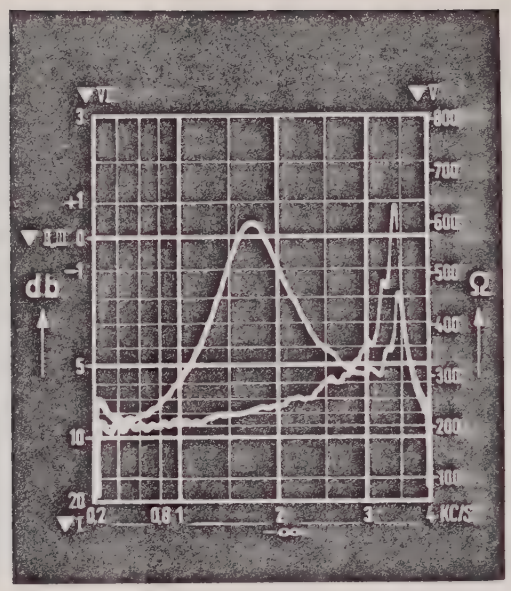


Fig. 17

Impedance comparison of a line with incorrectly adjusted balancing network

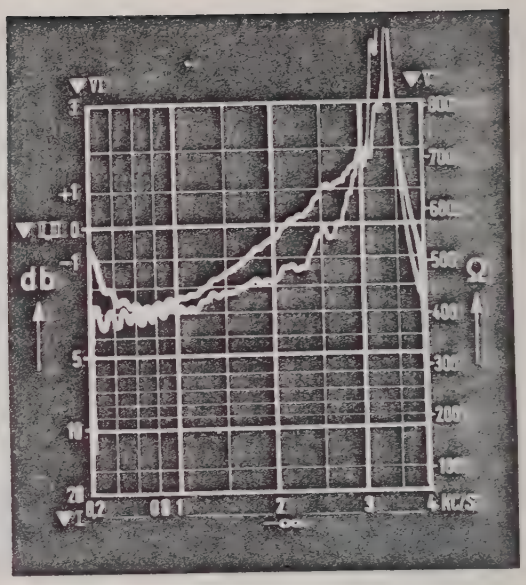


Fig. 18

Impedance comparison of line of Fig. 6 with correctly adjusted balancing network

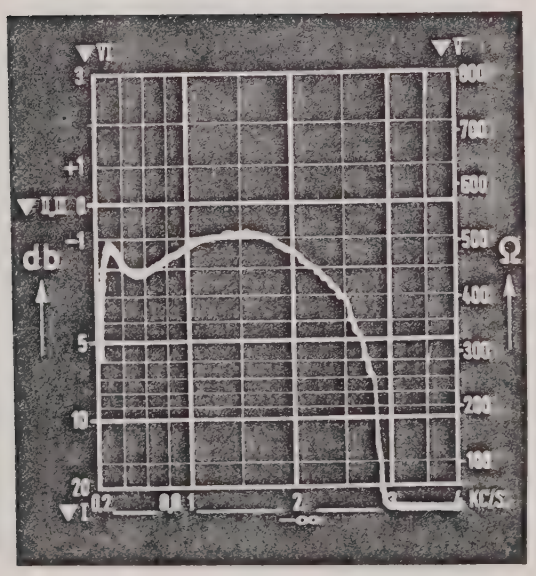


Fig. 21

Overall equivalent of loaded cable pair (H 175)

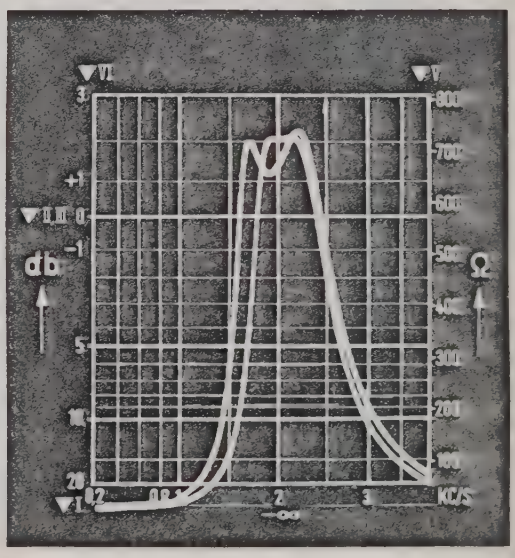


Fig. 22

Comparison of a filter to be tested with a standard. The curve shown with a deformed top pertains to the filter not yet adjusted.

N O T E S O N M A I N T E N A N C E

When skillfully handled and operated, the level tracer will require but a nominal amount of maintenance effort.

Caution: Before opening the device, be sure to pull the power plug (dangerous potentials). Loosen subsequently the eight panel screws, grip behind the panel and withdraw the chassis.

It is recommended to apply selector grease at greater intervals of time to the wiping contacts at the axle of the variable capacitor (annexed Fig. 2 in the "Parts List, ..." part) and to the bearing of the control knob (accessible from the front after taking down the control knob). Not under any circumstances must the switches be treated with greasy or grease-solving agents. Otherwise it will suffice to dust the device carefully at times.

When replacing the graticule, static charges may develop by friction between the plexiglass plate and the CRT. This effect can be suppressed by applying an anti-static paste (e.g. of the Faber company, Neu-Isenburg).

Determine and replace wornout or damaged tubes by checking in a tube tester.

In replacing the CRT the following sequence must be observed.

1. The device must be fully separated from the mains;
2. Withdraw the socket and the envelope terminal of the postacceleration electrode from the cathode ray tube;
3. Swing up the graticule frame on the screen and take down the graticule;
4. Loosen the clamp at the tube base;
5. Withdraw the tube;
6. Insert the new tube, tighten the clamp initially only slightly so that the tube can still be rotated;
7. Apply the graticule;
8. Reapply the socket and the envelope terminal of the postacceleration electrode onto the tube;
9. Energize the device (Caution: High voltage appears in the power supply unit and at the lead to the envelope terminal);
10. Place the device into operation: Operate all rotary controls to their CCW stops and operate S6 to MOTOR OPERATION. A line must now be traced out at the lower edge of the graticule. See to it that brightness and focus settings can be optimized. In the position " ▼ II" of S4 trace out the zero line; rotate subsequently the tube, with the device disconnected, in a way that the trace coincides with the 0-db line of the graticule. If need arises, make an adjustment with the calibrating knob " ▼ II" (P2).
11. Firmly tighten the clamp on the base of the tube, gently pushing the tube against the graticule.

For transportation, where heavy jolts can be anticipated, place the supplied wooden frame between front panel and lid.

F A U L T E L I M I N A T I N G

I. TESTING INSTRUCTIONS

1. General

These instructions comprise all measurements that are necessary for checking the characteristic data of the level tracer Type K211-G214 or g1a. It is assumed that the device performs its basic functions properly. They are suitable for a regular testing service.

As to fault locating, special instructions will be published.

Since the various adjustments might affect each other, the order of the checking measurements should be adhered to as strictly as possible. At the end of the respective measurement reference has again been made to the influence of other adjustments.

The positions of the aligning elements are specified for each measurement to eliminate the necessity of consulting the wiring diagram.

The measuring procedures are largely illustrated to facilitate the understanding.

① ② are item numbers that

a. state the order of the measurements,

b. link the adjustments on the various controls (e.g. switches, potentiometers) with the respective indication (e.g. on the screen).

Controls that must be adjusted in the respective measurement are filled in black.

The same applies to jacks to which a device is connected.

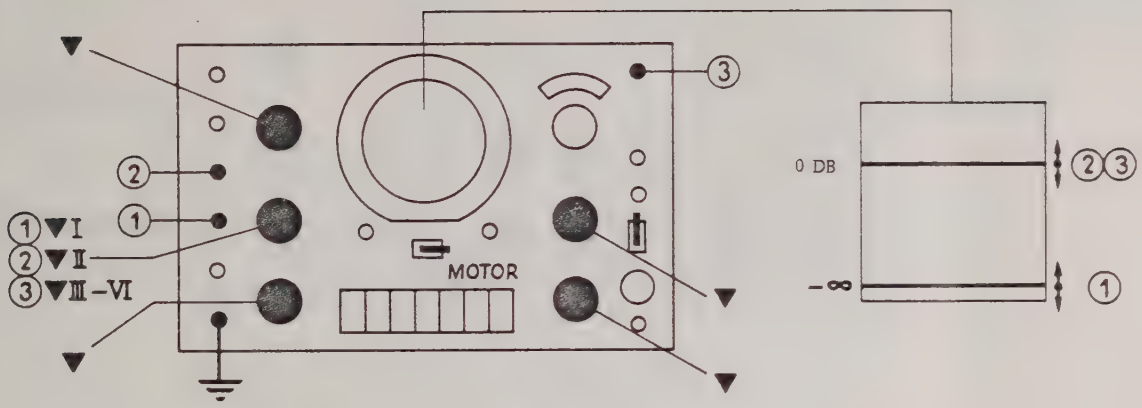
The measuring circuits given are normally single-line diagrams. Double-line diagrams are exceptional.

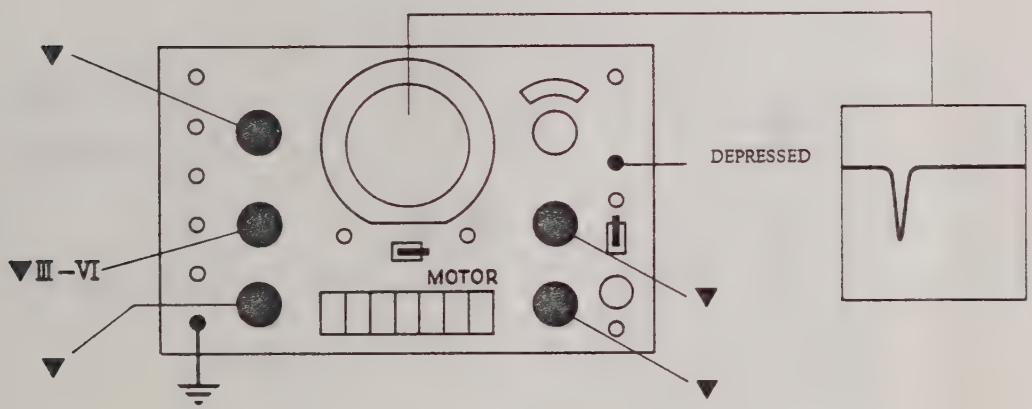
> All measurements must be made with the device allowed to warm up (at least 15 minutes warmup).

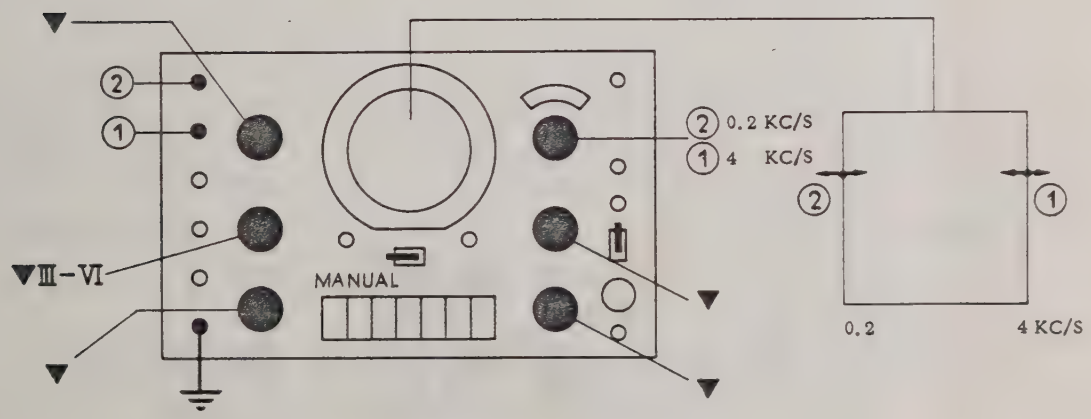
The following measuring instruments are required:

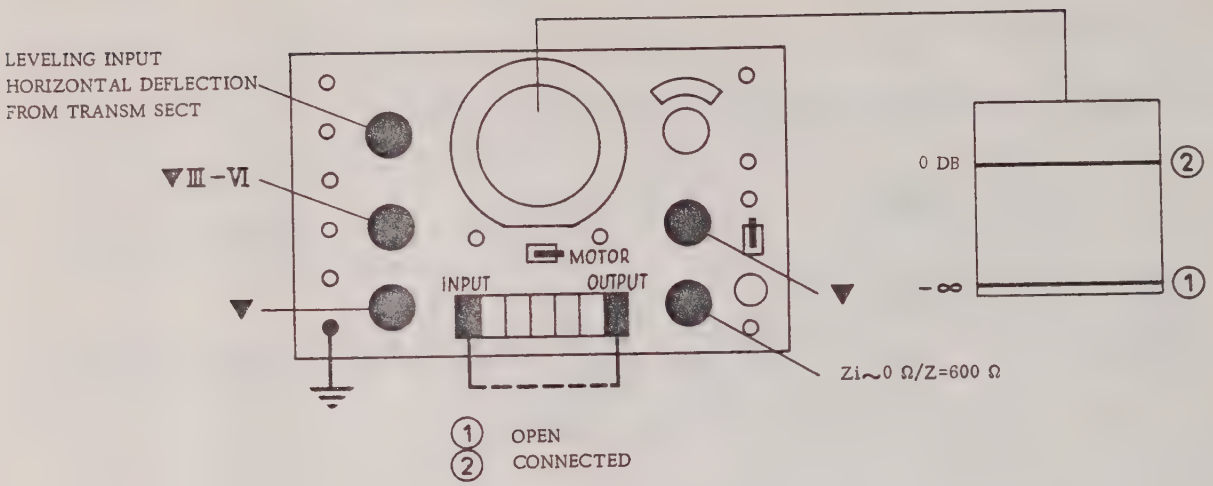
Universal instrument for DC (approx. 50 kΩ/v)
Variable attenuator Z = 600 Ω (balanced)
Level oscillator 0.2 to 20 kc/s (+20 db/$Z_i \sim 0$ Ω)
Level meter 0.2 to 20 kc/s (-40 db / $Z_i > 30$ kΩ)
Frequency measuring equipment (accuracy 1×10^{-5})
Decade resistor (0 to 1 meg).

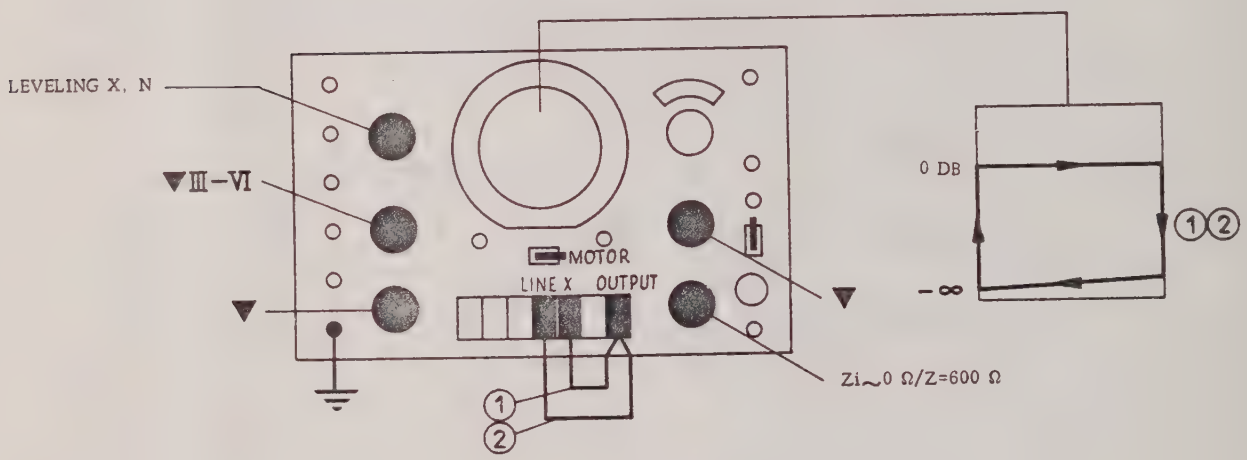
2. General Function Check

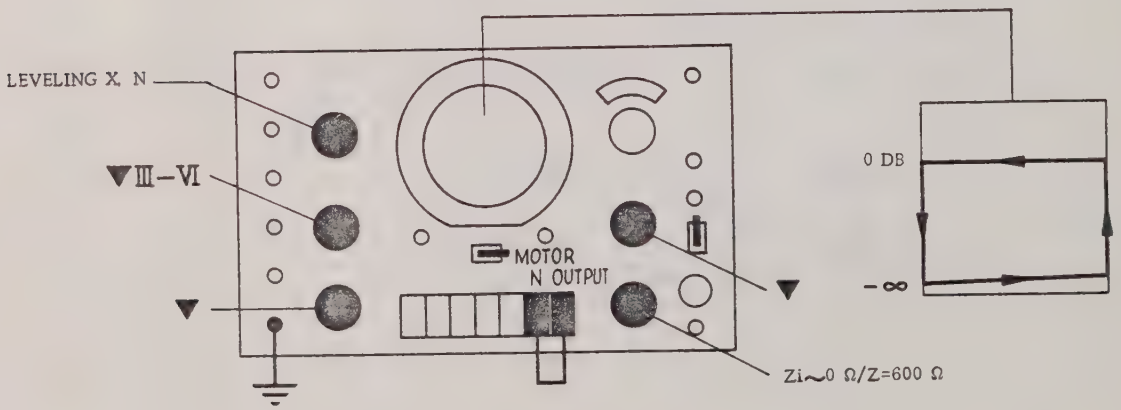


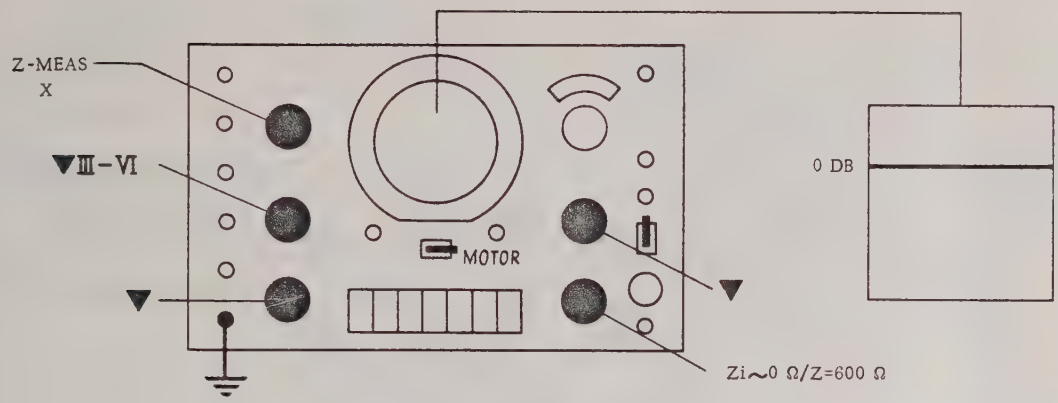


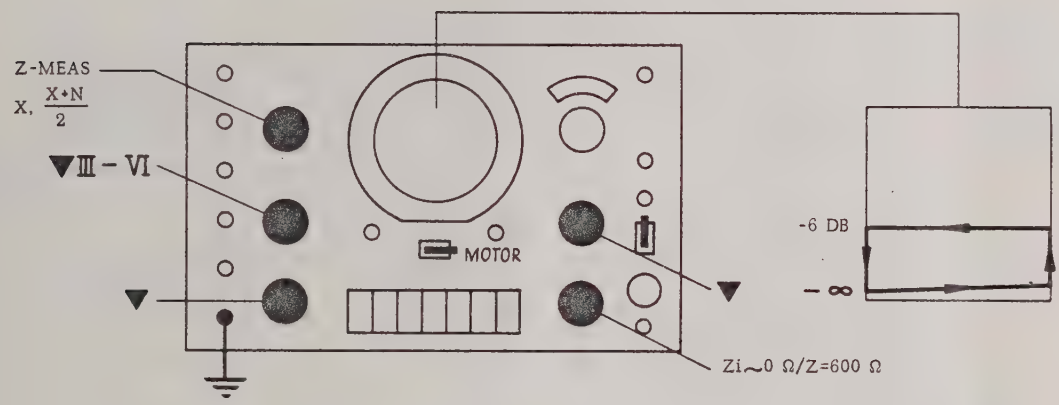


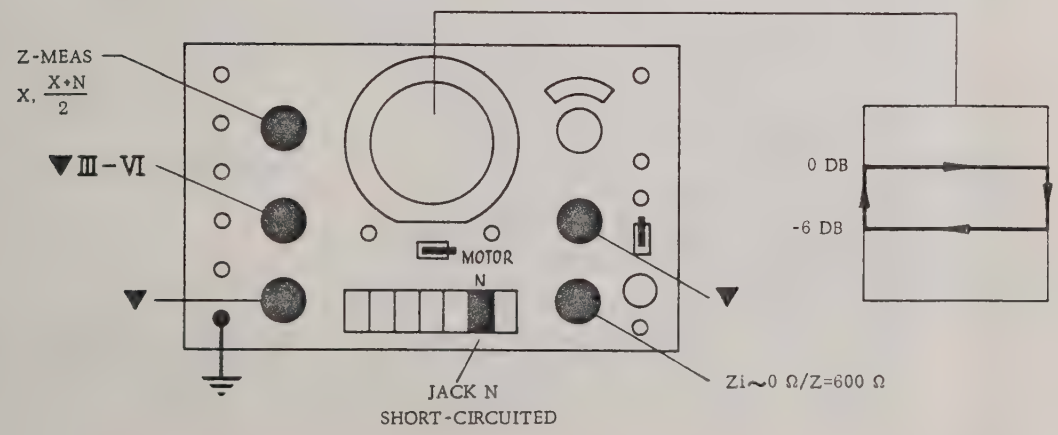

LEVELING INPUT
HORIZONTAL DEFLECTION
FROM TRANSM SECT
▼III–VI
▼
MOTOR
INPUT
OUTPUT
0 DB
-∞
2
1
Zi~0 Ω/Z=600 Ω
1 OPEN
2 CONNECTED

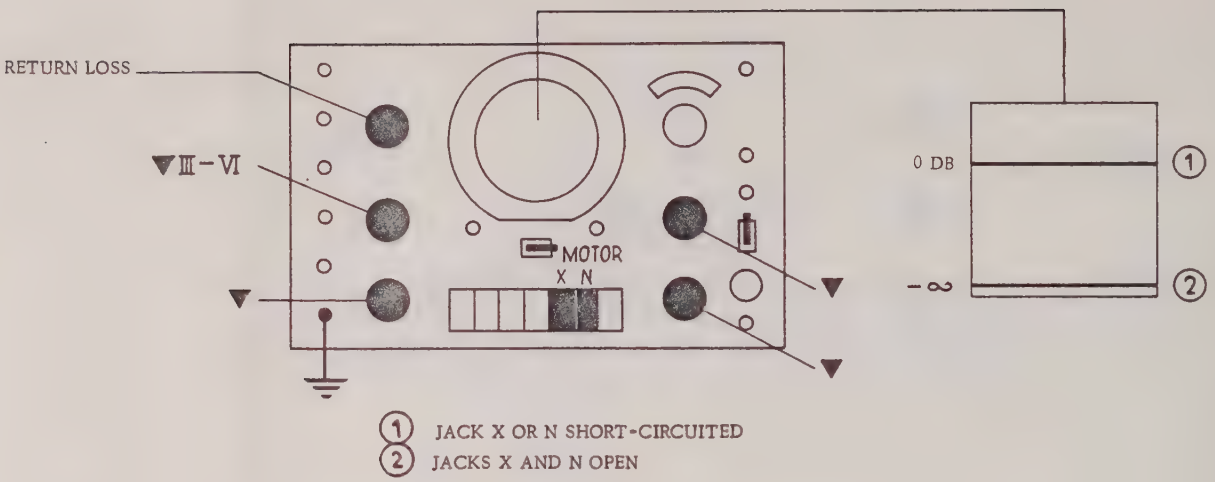

LEVELING X, N
▼III–VI
▼
MOTOR
LINE X
OUTPUT
0 DB
-∞
1 2
Zi~0 Ω/Z=600 Ω
1
2


LEVELING X, N
▼III–VI
▼
MOTOR
N OUTPUT
0 DB
-∞
Zi~0 Ω/Z=600 Ω

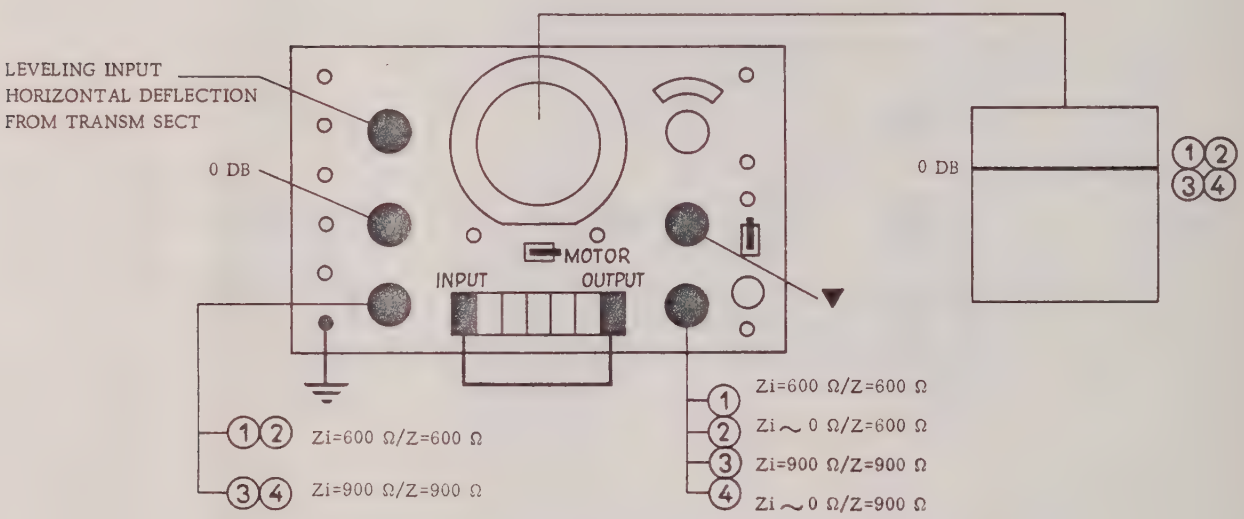

Z-MEAS
X
▼III-VI
MOTOR
0 DB
Zi∼0 Ω/Z=600 Ω

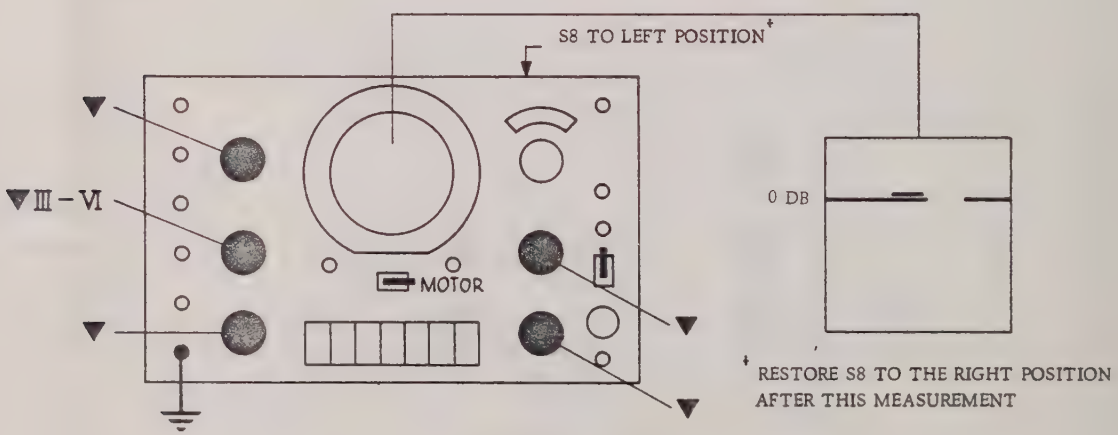

Z-MEAS
X, X+N/2
▼III-VI
MOTOR
-6 DB
-∞
Zi∼0 Ω/Z=600 Ω


Z-MEAS
X, X+N/2
▼III-VI
MOTOR
N
0 DB
-6 DB
Zi∼0 Ω/Z=600 Ω
JACK N
SHORT-CIRCUITED



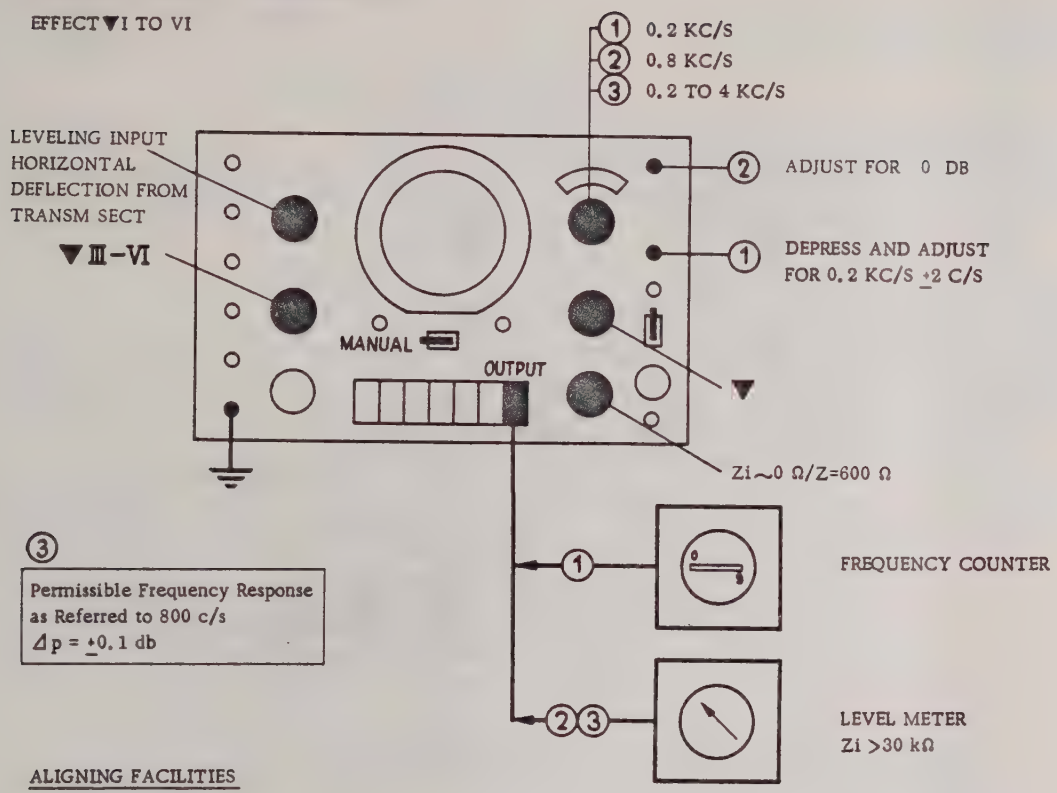
1 JACK X OR N SHORT-CIRCUITED
2 JACKS X AND N OPEN





† RESTORE S8 TO THE RIGHT POSITION AFTER THIS MEASUREMENT

3. Frequency Response of Transmitting Section

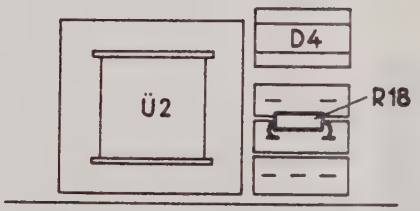


ALIGNING FACILITIES

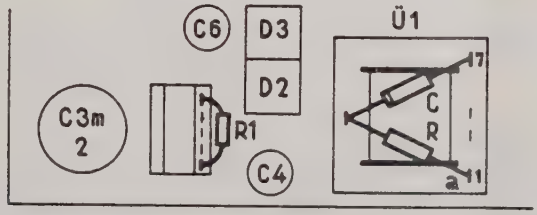
at high frequencies:
with R18 (R18 = 80 to 100 Ω)

at low frequencies:

R1 is removed and an R-C series network connected between the soldering lugs 1a and 7a of transformer Ü1.
R = 300 to 800 kΩ
C = 5000 µµf (styroflex capacitor)



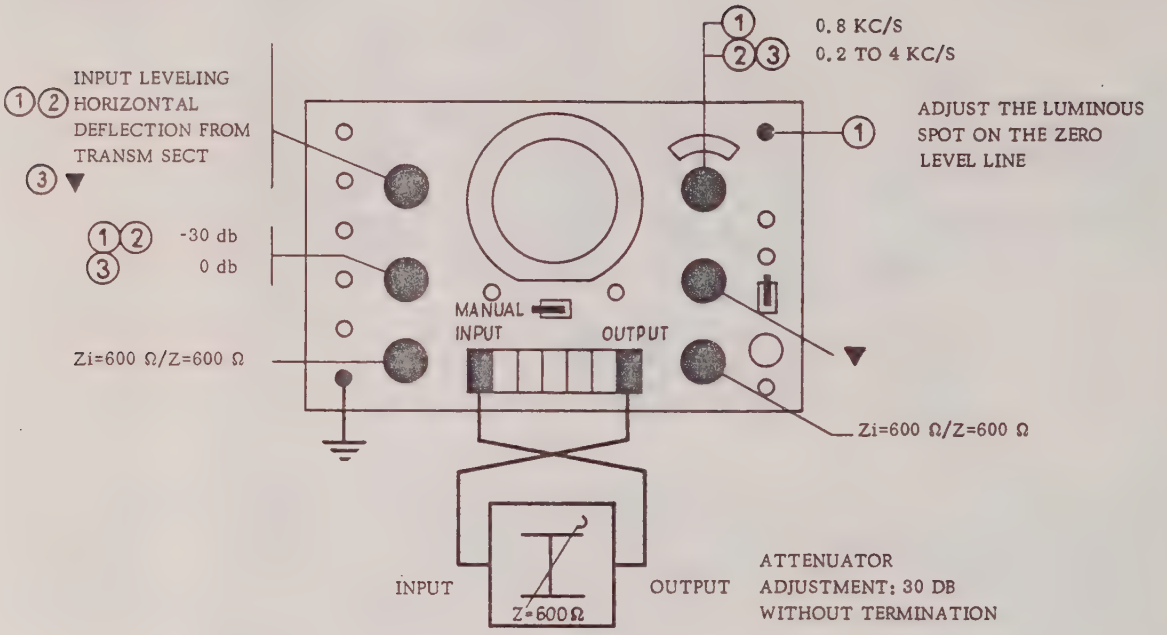
TRANSMITTING SUBASSEMBLY (LOWER CENTER)



TRANSMITTING SUBASSEMBLY AS SEEN FROM INSIDE THE DEVICE

4. Frequency Response of Receiving Section

Check ▼ I and II



2 3 | Permissible Frequency Response, as Referred to 800 C/S

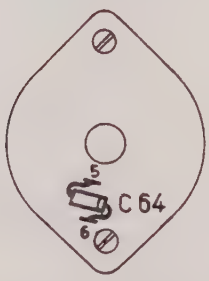
$\Delta p = \pm 0.2$ db

Aligning Facilities:

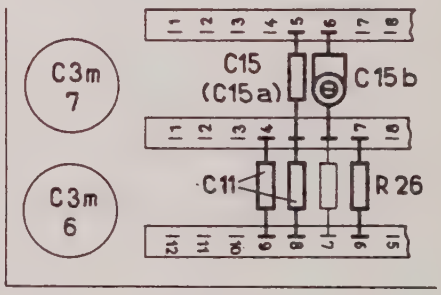
with (2) at high frequencies: with C15 (or C15a and C15b).

with (3) at high frequencies: insert a capacitor (C64) of up to 20 µµf between the soldering lugs 5 and 6 of the soldering plate of switch S4.

with (3) at low frequencies: with C11 and R26.



SOLDERING-LUG PLATE OF SWITCH S4

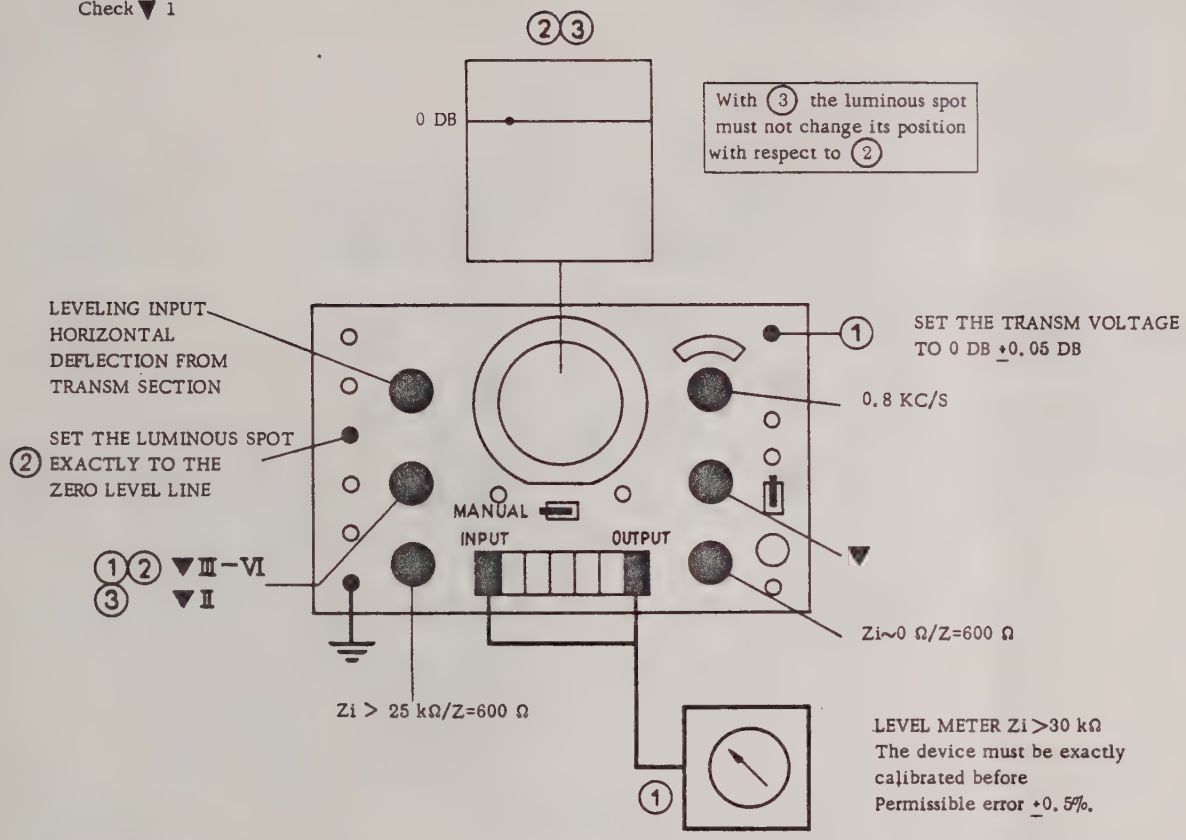


RECEIVING SUBASSEMBLY

When a value of the degeneration path of the amplifier is changed (C11/C15/R26), it is absolutely necessary for the calibrating level (see 4) to be checked and, if necessary, readjusted.

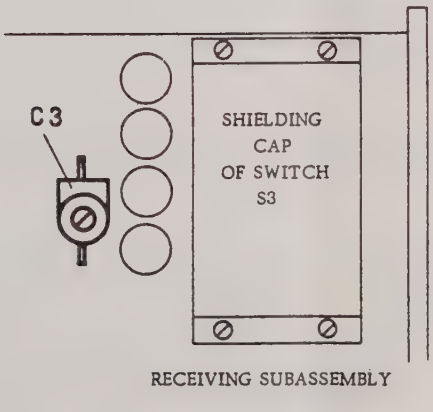
5. Adjusting the Calibrating Level

Check ▼ 1


2 3
0 DB
With 3 the luminous spot must not change its position with respect to 2
LEVELING INPUT HORIZONTAL DEFLECTION FROM TRANSM SECTION
SET THE LUMINOUS SPOT
2 EXACTLY TO THE ZERO LEVEL LINE
1 2 3 ▼III–VI ▼II
1
SET THE TRANSM VOLTAGE TO 0 DB ±0.05 DB
0.8 KC/S
MANUAL
INPUT
OUTPUT
Zi~0 Ω/Z=600 Ω
Zi > 25 kΩ/Z=600 Ω
1
LEVEL METER Zi >30 kΩ
The device must be exactly calibrated before
Permissible error ±0.5%.

Aligning Facilities

In position 3 the luminous spot is exactly set to the zero level line with the trimmer C3. For checking, S4 must again be switched to "▼ III to IV". In either position the luminous spot must be at the same place.

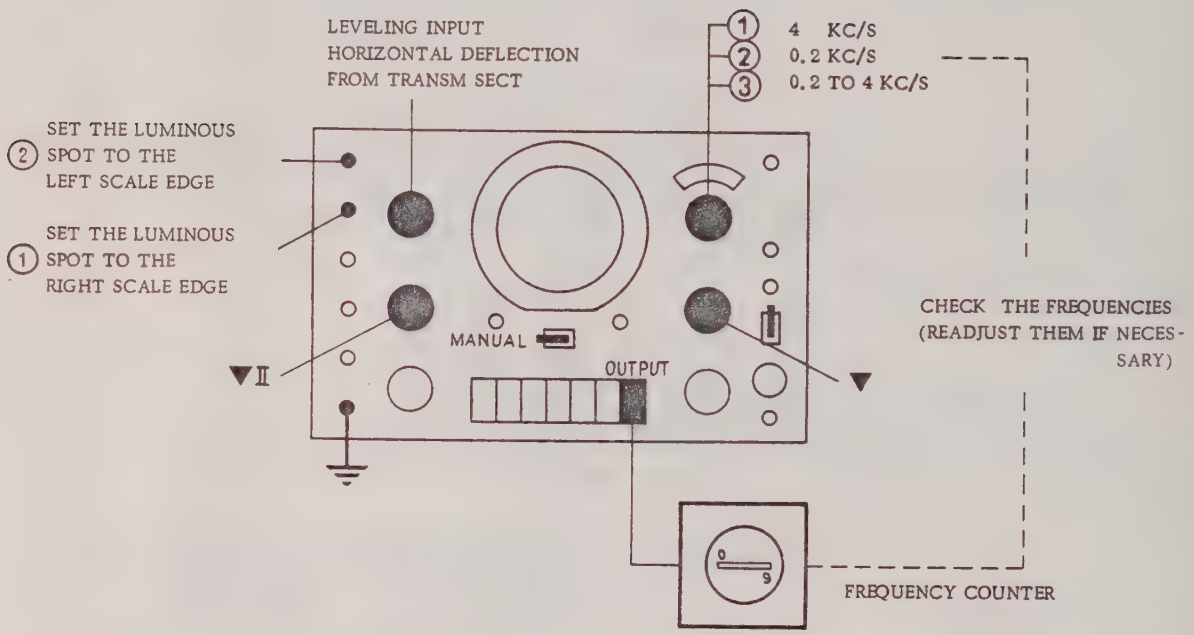


After the alignment no modification must be effected in the degeneration path of the amplifier (C11/C15/R26)! (See also section 3. Frequency Response of the Receiving Section).

6. Checking the Screen Graticule/Frequency Graduation

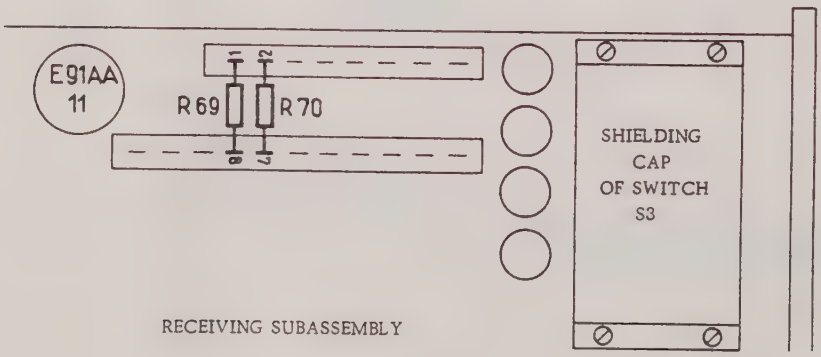
Check ▼ I to IV

Alternate between (1) and (2) until both scale edges are exactly calibrated!



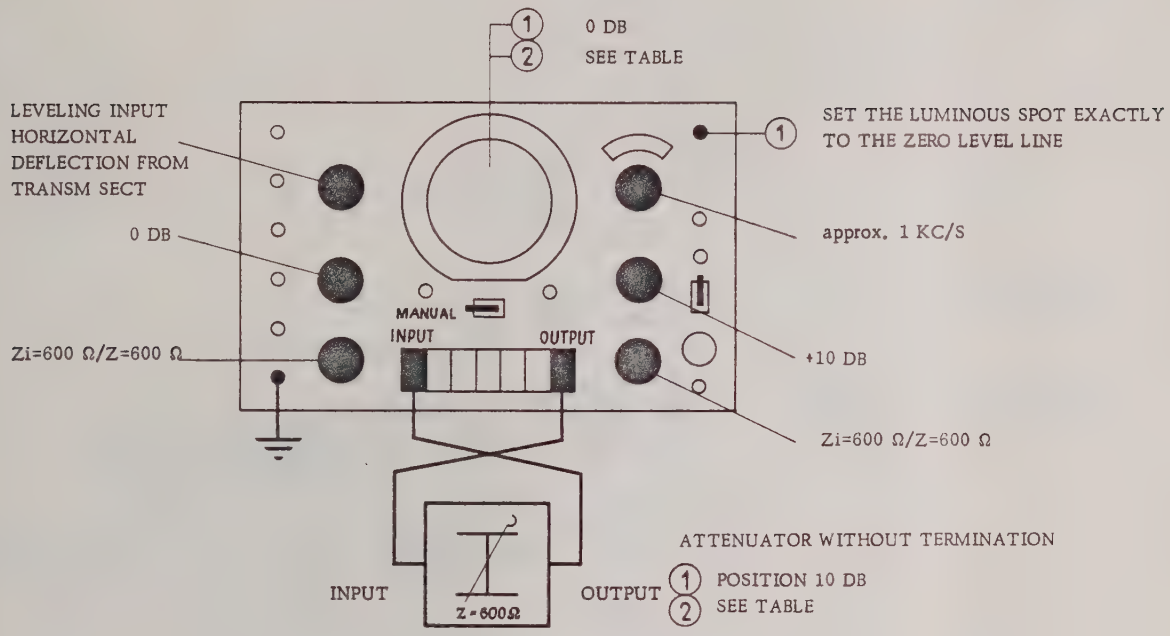
Permissible deviations of the frequency indication		
a. on the zero level line	±5%	±25 c/s
b. additionally for the rest of the level scale	±3%	±20 c/s
c. additionally with a mains voltage variation of ±10%	±3%	±20 c/s

Aligning Facilities: from 0.2 to about 3 kc/s with R69,
from 2 to 4 kc/s with R70.



7. Checking the Screen Graticule/Decibel Graduation

Check ▼ I to III

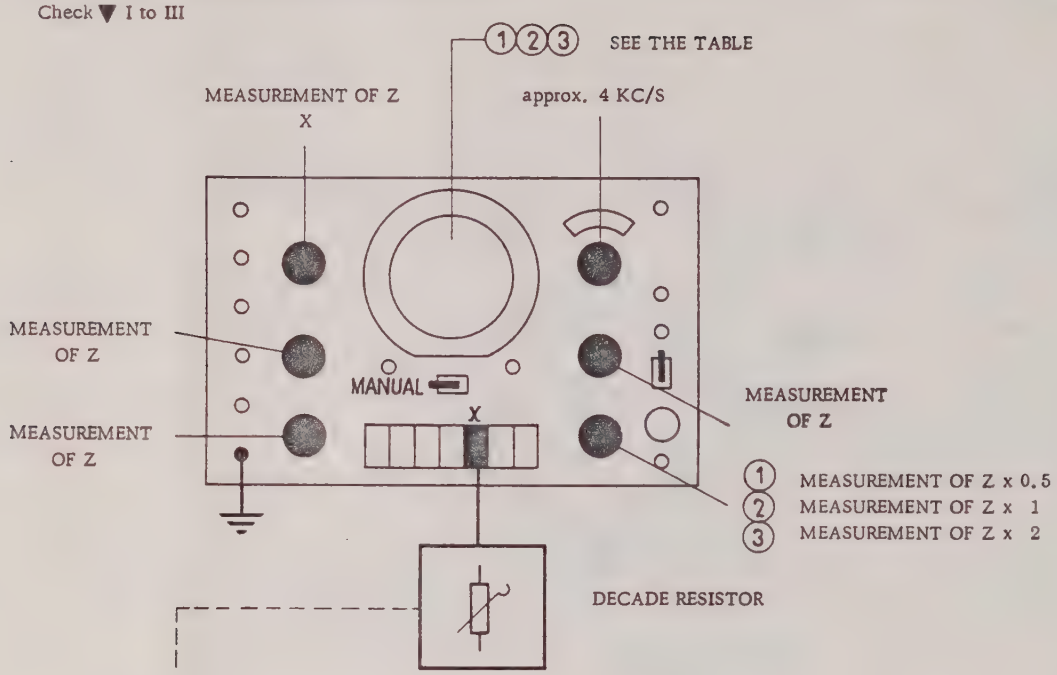


Variable Attenuator db	Reading db	Permissible Deviation db
7 8 9	+3 +2 +1	±0.2
10	0	0
11 12 13 14 15	-1 -2 -3 -4 -5	±0.2
16 17 18 19 20 21 22	-6 -7 -8 -9 -10 -11 -12	

(2)

8. Checking the Screen Graticule / Ohm Graduation

Check ▼ I to III

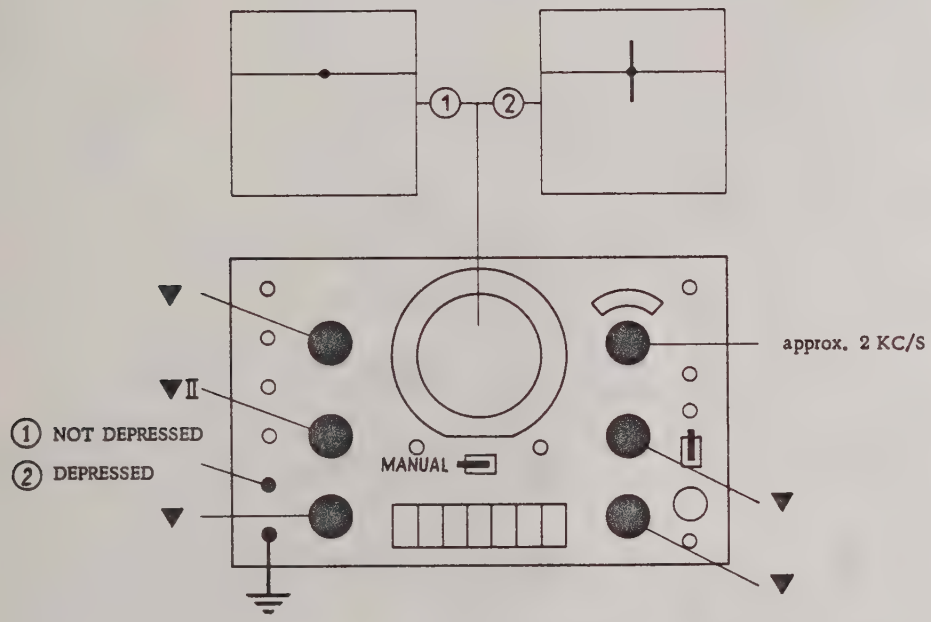


	Decade Resistor Ω	Indication Ω	Permissible Deviation
1	1200	600	
2	800	800	±10% as referred to the full-scale value
	700	700	
	600	600	
	500	500	
	400	400	
	300	300	
	200	200	
	100	100	
3	300	600	

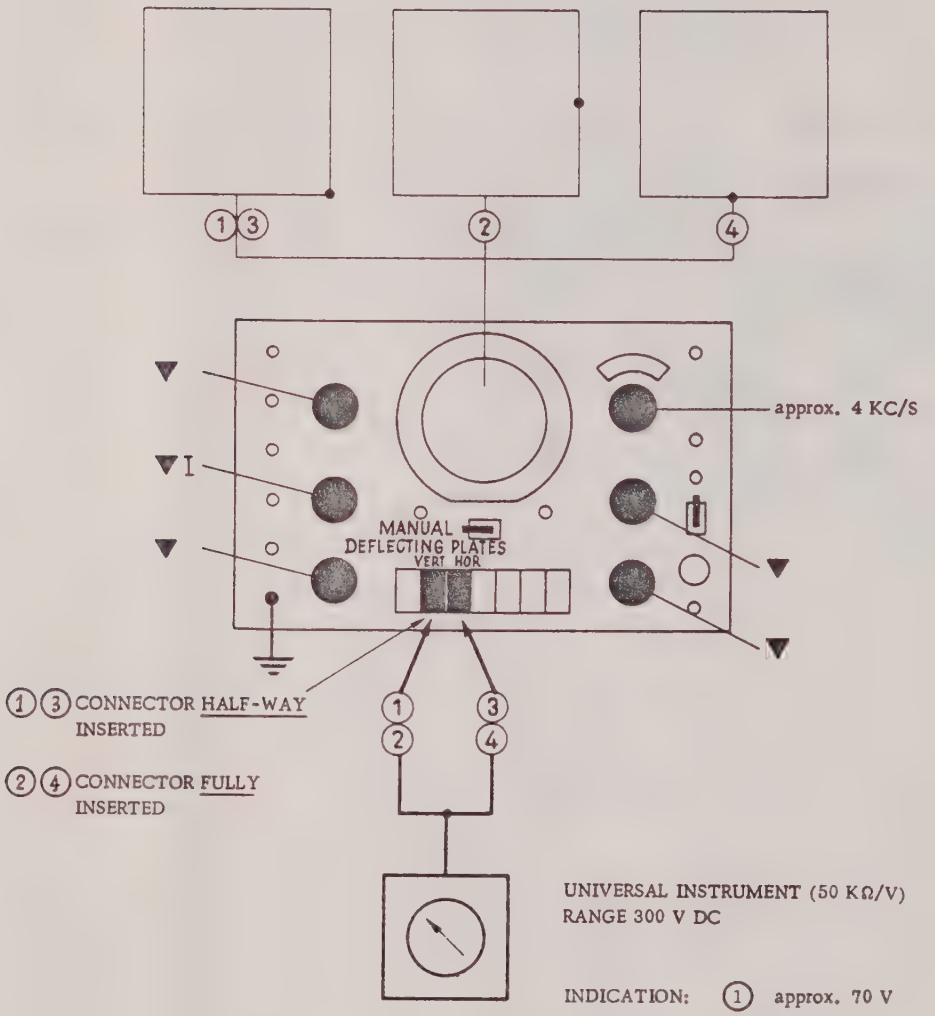
Aligning Facilities:

Alignment is only necessary when the output transformer Ü2 has been replaced in the oscillator (see the instructions on fault locating and fault eliminating).

9. Function Check of the Pushbutton "Frequency Marker"

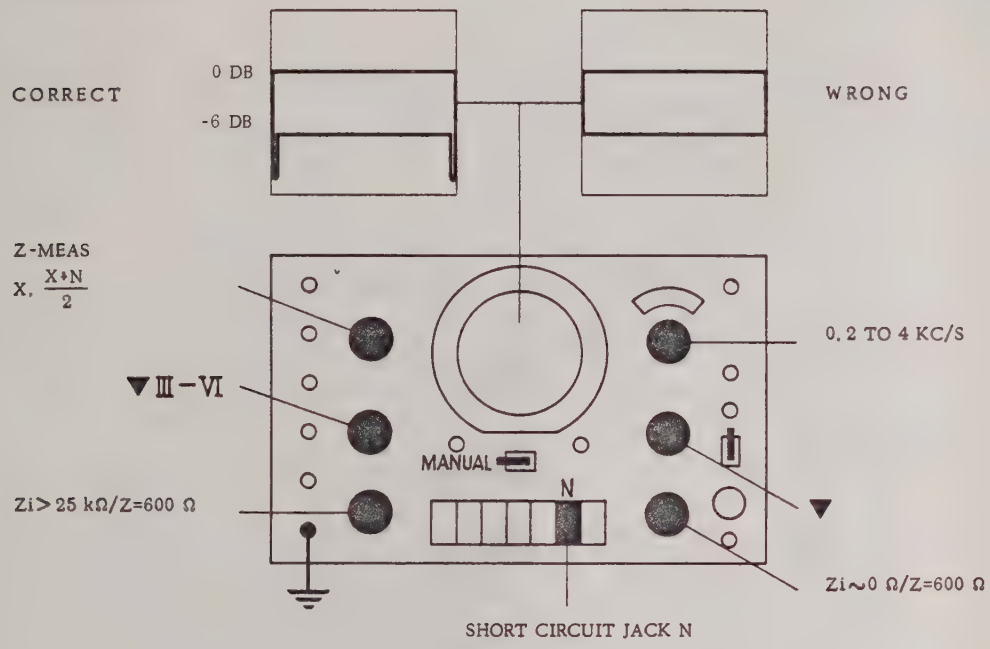


10. Checking the Jacks "Deflecting Plates"



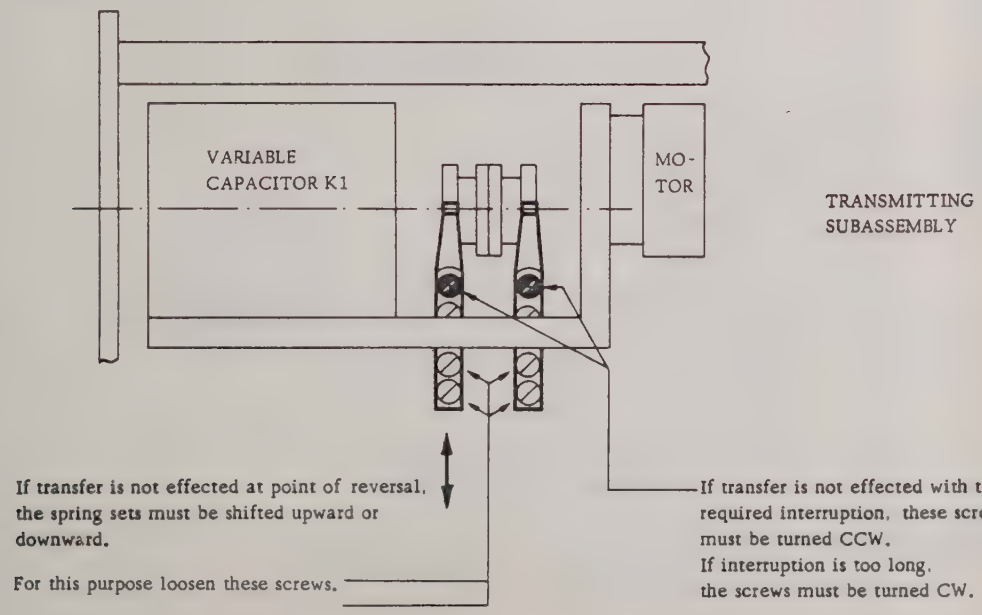
11. Adjustment of the Cam Contacts for the Measurement of X/N

Check ▼ I to VI



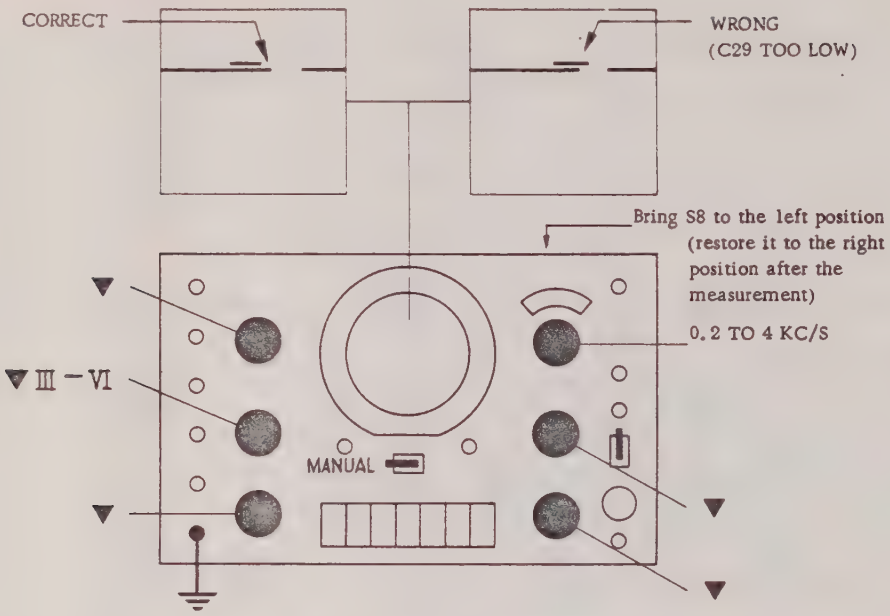
The transfer must be effected exactly at the point of reversal (0,2 kc/s/4 kc/s) and with a short interruption.

Aligning Facilities


VARIABLE CAPACITOR K1
MO-TOR
TRANSMITTING SUBASSEMBLY
If transfer is not effected at point of reversal, the spring sets must be shifted upward or downward.
For this purpose loosen these screws.
If transfer is not effected with the required interruption, these screws must be turned CCW.
If interruption is too long, the screws must be turned CW.

12. Adjusting the Cams for Omitting the Zone of the Tone Dialling Signal

Check ▼ I to VI.

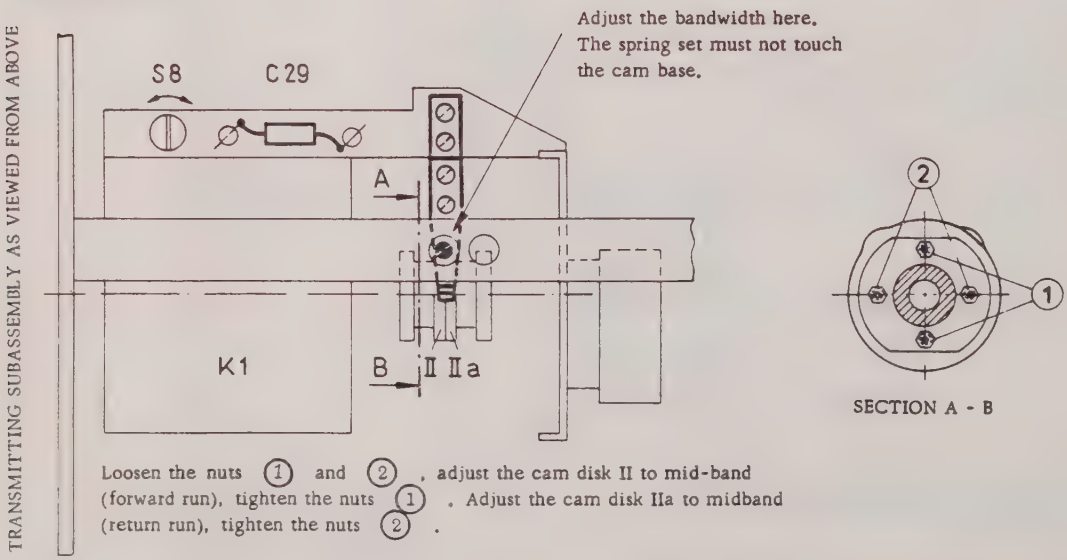


In the forward and the backward runs of the variable capacitor K1 the following frequency band must be skipped:

2400 ± 25 c/s to 2800 ± 25 c/s

When the cam switch NS is closed, the maximum adjustable frequency must not be above 2350 c/s.

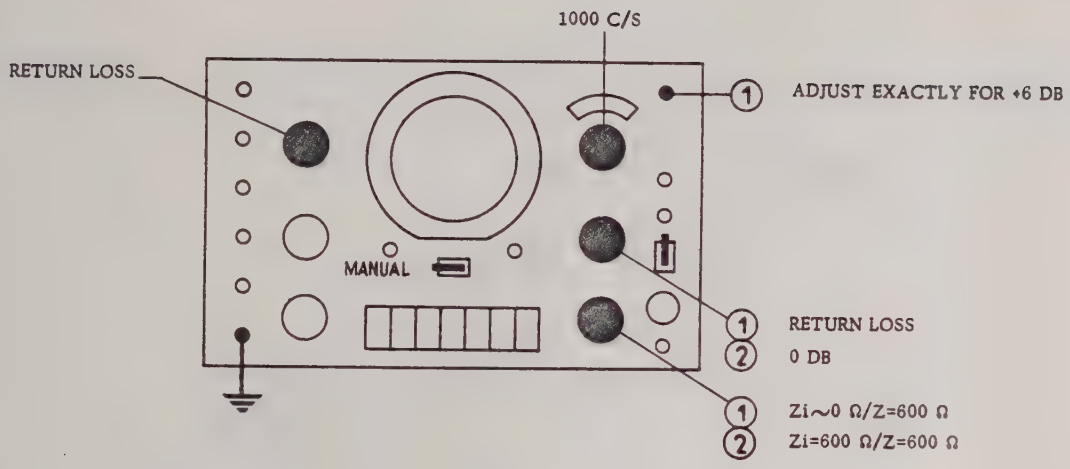
Aligning Facilities

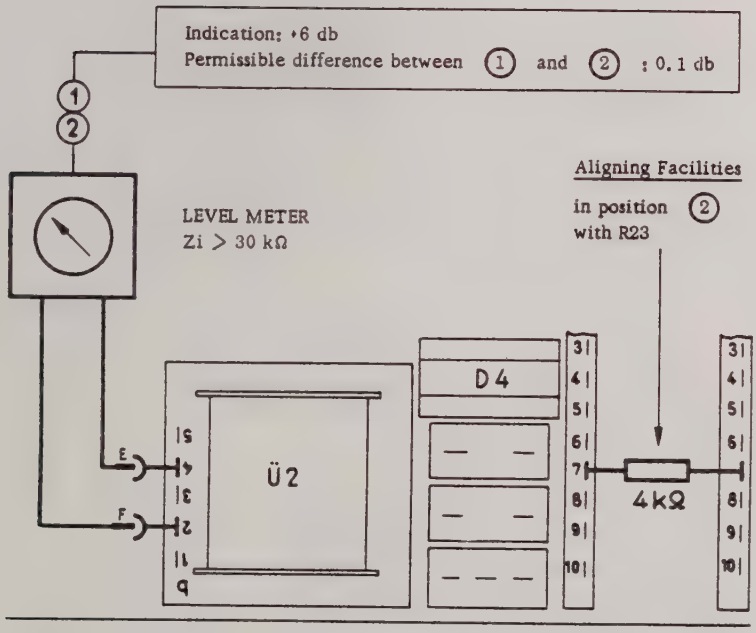


Loosen the nuts (1) and (2), adjust the cam disk II to mid-band (forward run), tighten the nuts (1). Adjust the cam disk IIa to midband (return run), tighten the nuts (2).

13. Checking the 6-db Step for Z = 600 Ω

Check ▼ I to III.



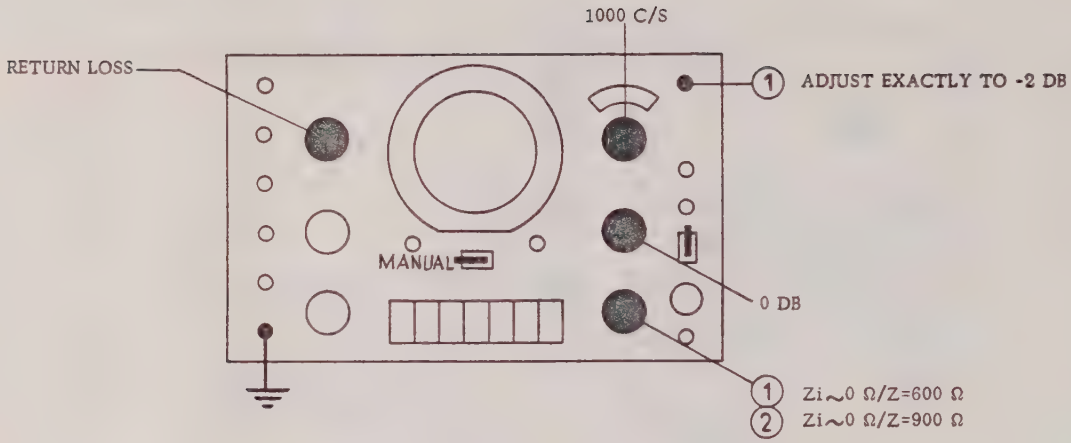


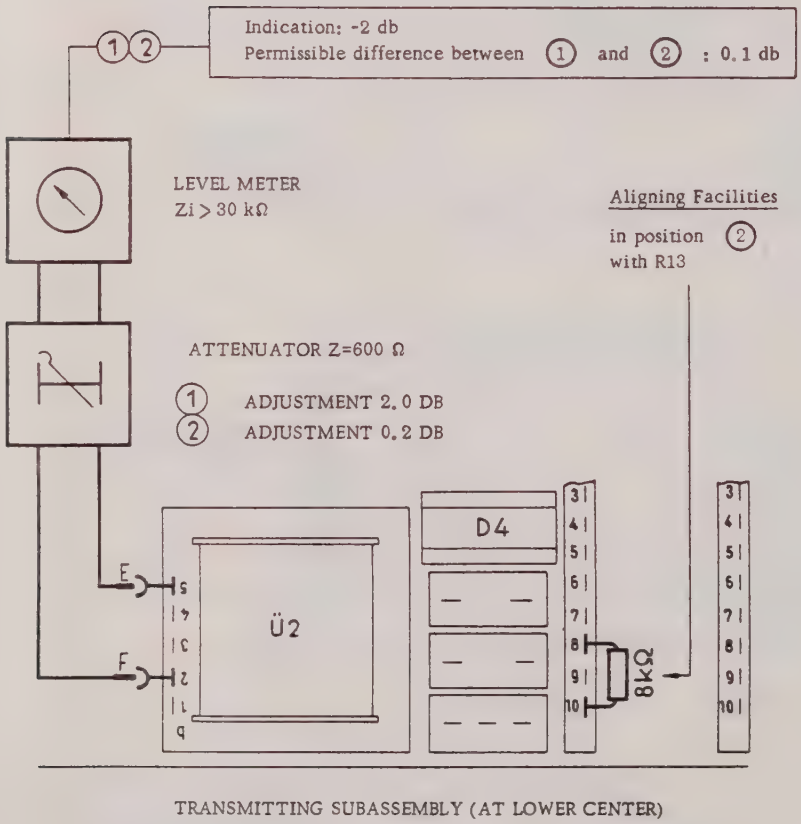
TRANSMITTING SUBASSEMBLY (AT LOWER CENTER)

VIKING LABORATORIES INC.

14. Checking the 1,8-db Step

Check ▼ I to III.

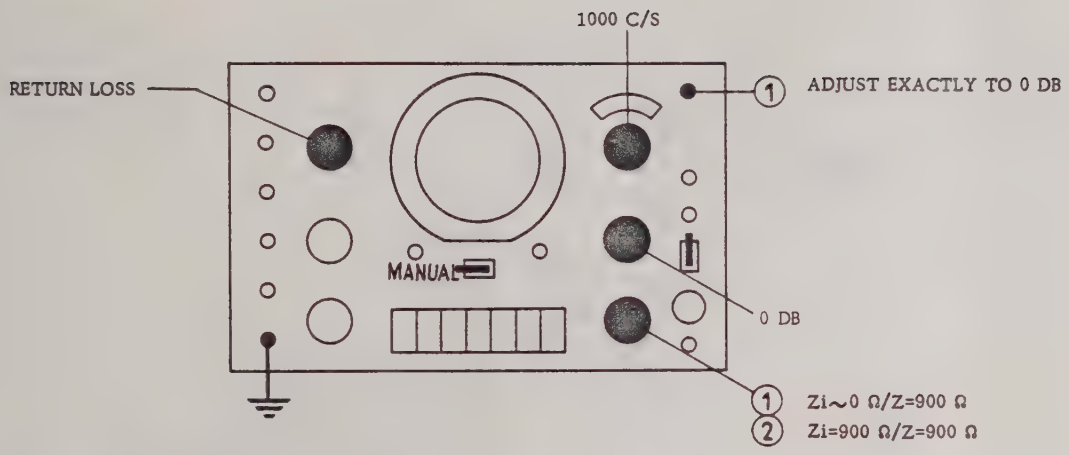


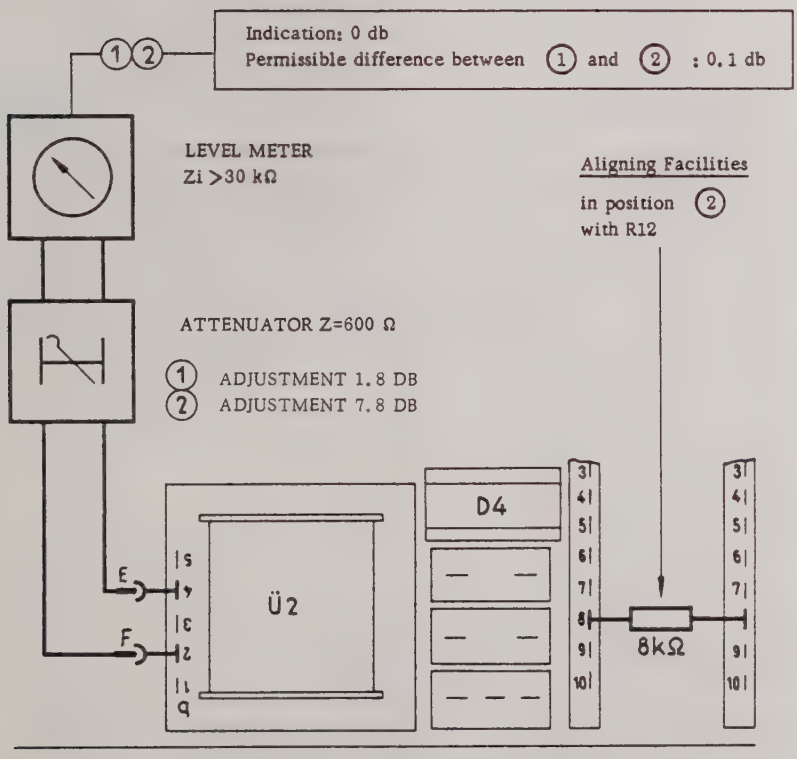


TRANSMITTING SUBASSEMBLY (AT LOWER CENTER)

15. Checking the 6-db Step for Z = 900 Ω

Check▼I to III.

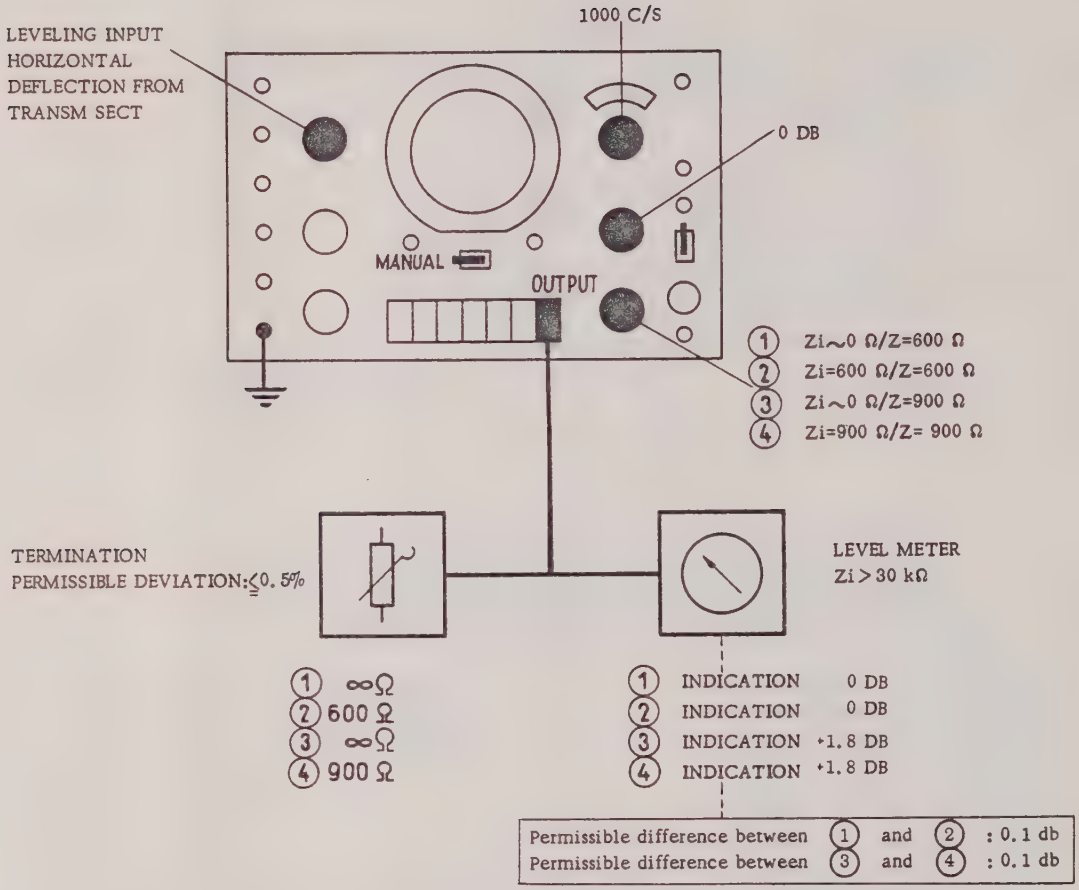




TRANSMITTING SUBASSEMBLY (AT LOWER CENTER)

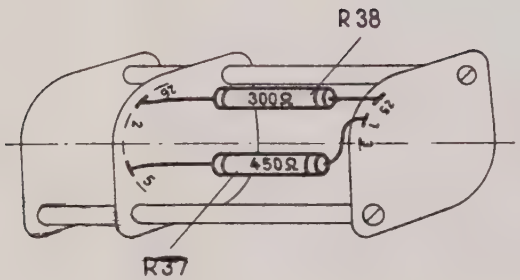
16. Checking the Source Impedances

Check ▼ I to III



Aligning Facilities:

In position (2) with R38
in position (4) with R37

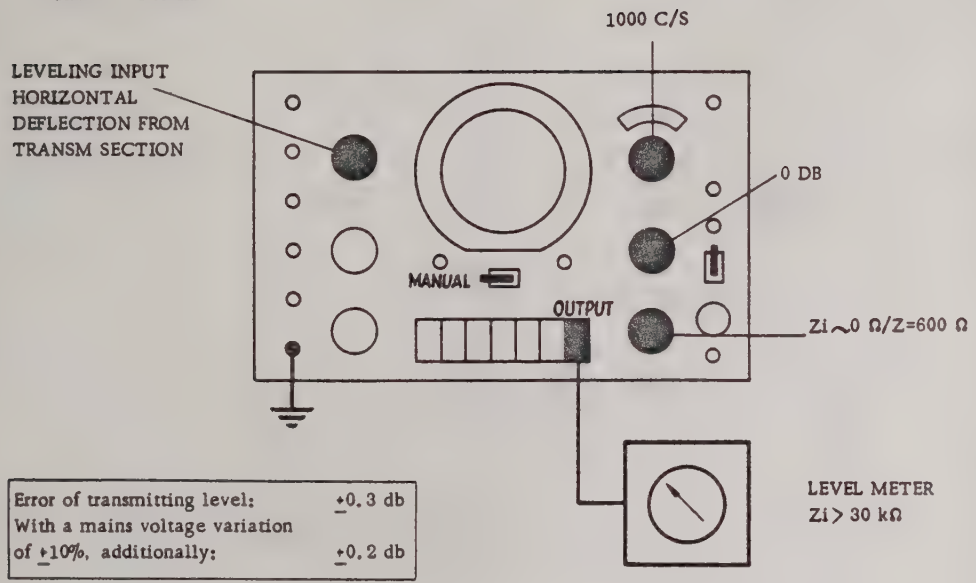


SWITCH S2

(in the Transmitting Subassembly at lower left)

17. Checking the Transmitting Level

Check ▼ I to III



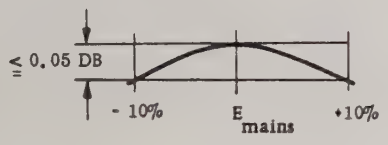
Error of transmitting level:	±0.3 db
With a mains voltage variation of ±10%, additionally:	±0.2 db

Aligning Facilities

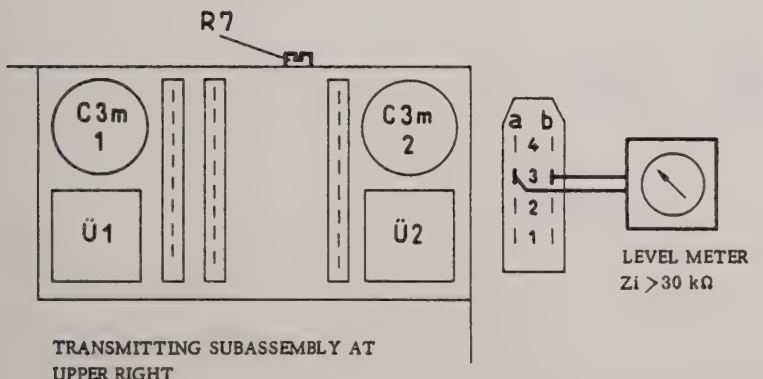
When the transmitting level is not correct, though ▼ I to III have been exactly set, the fault can only be due to the adjustment of the calibrating level (see item 4 /page 9)

With excessive dependence on mains voltage variations, the incandescent lamp bridge in the fixed oscillator must be readjusted.

R7 must be so adjusted that the level at the points a3/b3 of the blade contact strip does not change by more than 0.05-db with a mains voltage variation of ±10%.

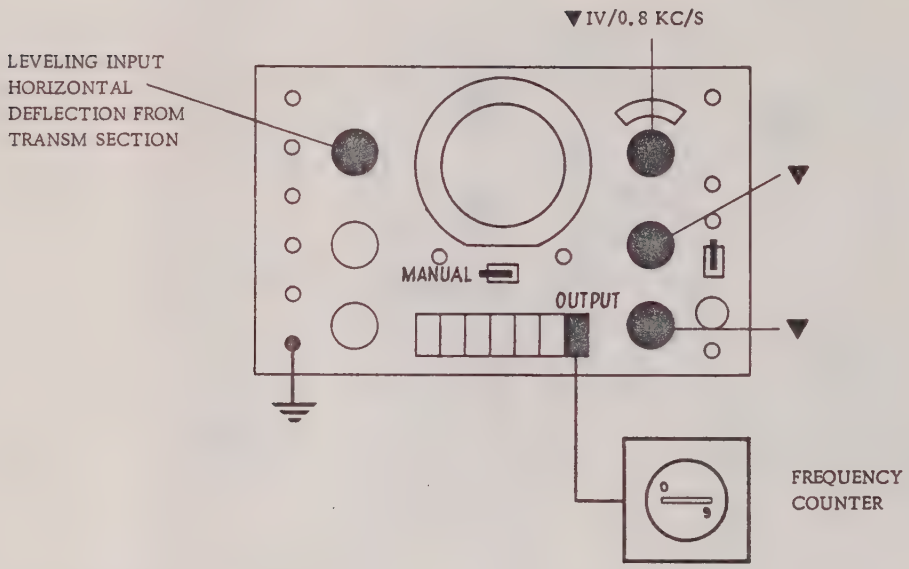


REPEAT ▼III



18. Checking the 800-c/s Wave Trap

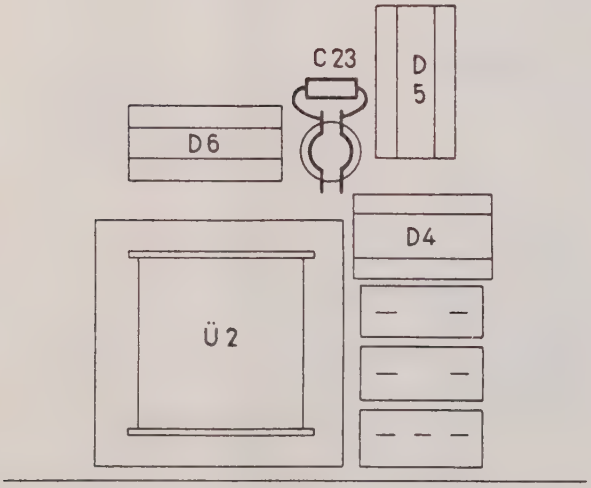
Check ▼ IV



Nominal frequency: 800 c/s ±1%

Aligning Facilities

When the oscillator frequency is too low, a lower value of C23 must be adjusted. When the frequency is too high, a greater value of C23 must be adjusted.
After each change of the value of C23 the calibration procedure " ▼IV" must be repeated.

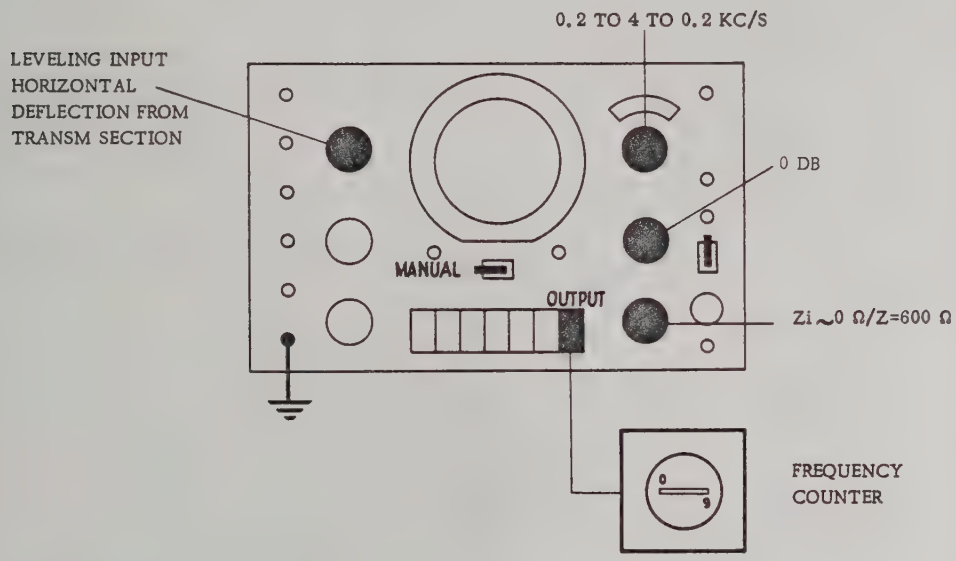


TRANSMITTING SUBASSEMBLY (AT LOWER CENTER)

19. Checking the Transmitting Frequency

The device must be slid into the casing prior to this measurement. Warmup time in the casing is at least 15 minutes.

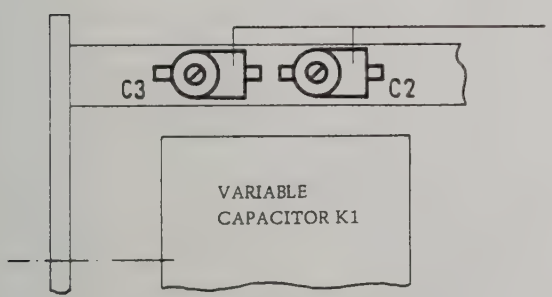
Check ▼ IV



Frequency error:	±3% ±20 c/s
With a mains voltage variation of ±10%, additionally:	±5% ±30 c/s

Aligning Facilities

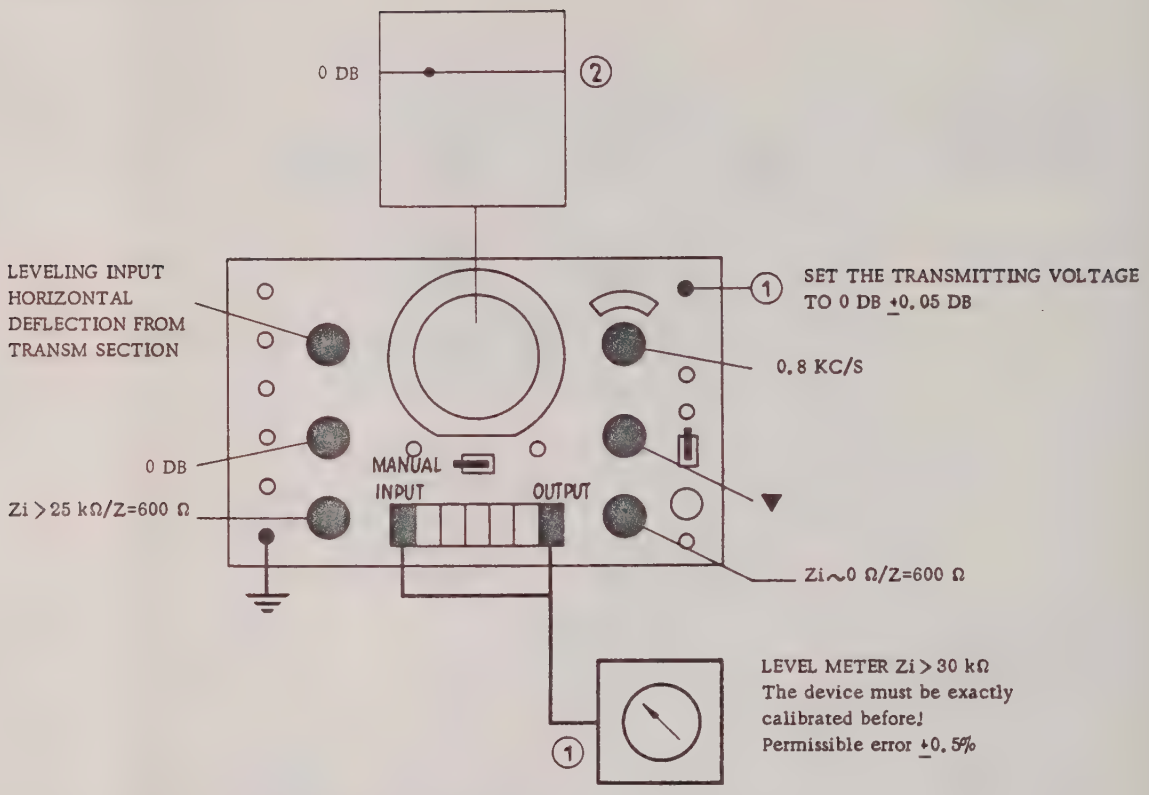
When all frequencies are shifted by the same amount both in the forward and the return runs, the alignment of the 800-c/s wave trap is incorrect. For the alignment refer to item 17/page 22 However, the luminous spot must reverse at 0.2 kc/s and at 4 kc/s. If such is not the case, the scale disk has shifted with respect to the shaft of the variable capacitor.
To eliminate this fault, the two screws in the scale support must be loosened and the variable capacitor at the cam disk set so adjusted that the luminous point is exactly at the left point of reversal. Keep the variable capacitor in this position and adjust the scale to "0.2 kc/s" with the rotary control, tightening the two screws again (hexagon socket wrench with a width of 1.5 mm).



The adjustment of these two trimmers must not be changed, or else the scale must be re-calibrated.

20. Checking the Receiving Level

Check ▼ I and II



②	Error of receiving level:	±0.2 db
	With a mains voltage variation of ±10%, additionally:	±0.1 db

Aligning Facilities

When the level indication is not correct though ▼ I and II have been exactly set, it is only the adjustment of the calibrating level that can be incorrect (see item 4/page 9)

No alignment for the dependence on mains voltage variations has been provided.

P A R T S L I S T

Introductory remarks

In the column headed Symbol the designations used in the circuit diagrams are listed in an alphabetical and, as far as possible, numerical order. Under the heading Qty. the number of equal components within a subassembly is given. The column Description contains, in addition to the description of the components, its main data.

The value of components marked "as mounted" is determined by alignment in the test room and can therefore be gathered from these parts themselves.

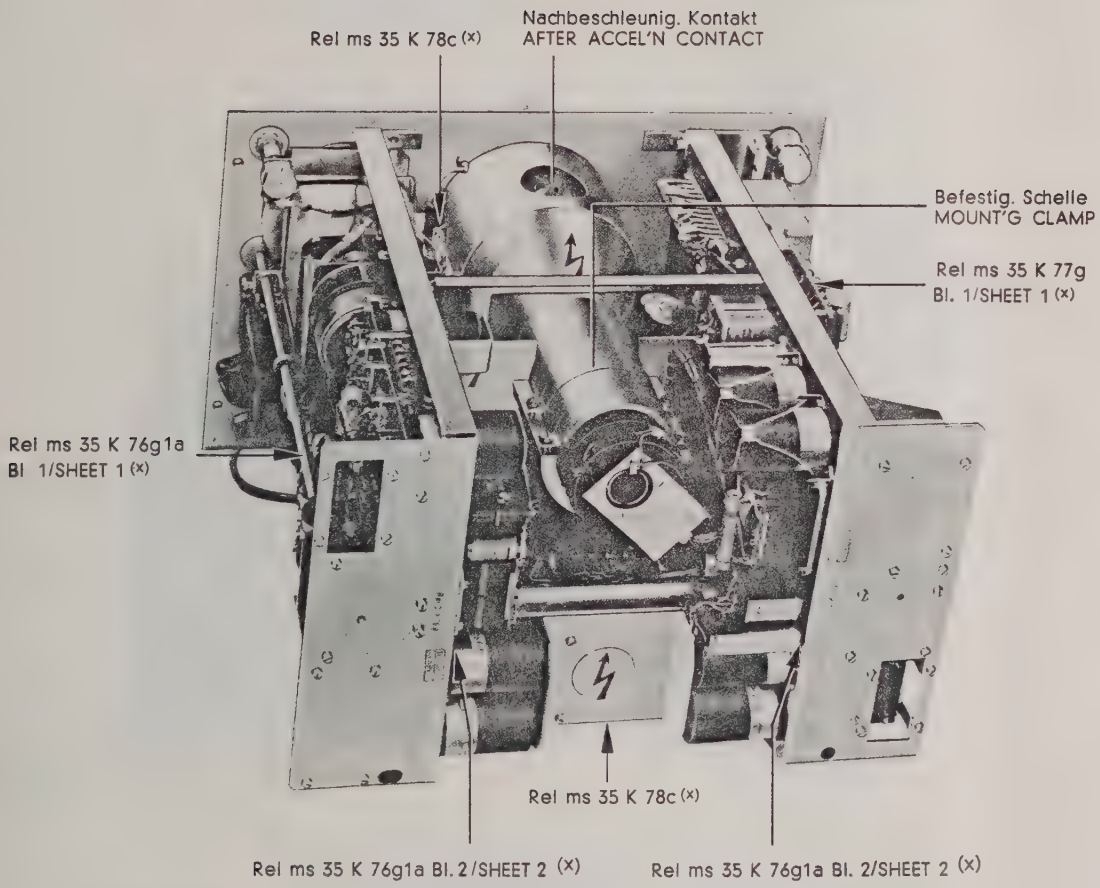
There denote, for instance,

with a layer-type resistor:	300 kΩ ±5% 0,5 W
300 kΩ	nominal value of the resistance
±5%	tolerance of the nominal resistance
0,5 W	load rating as referred to an ambient temperature of 20° C
with a wire-wound resistor:	4500 Ω ±0,5%; 0,05 Konst. SS unif.
4500 Ω	nominal value of the resistance
±0,5%	tolerance of the nominal resistance
0,05 Konst. SS unif.	of constantan wire (Konst.); 0.05 mm dia. double-silk insulation (SS); unifilarly wound (unif.)
with a capacitor:	1000 pF ±20% 125 V
1000 pF	nominal value of the capacitance (1 pF = 1 µµF = 10^{-12} F)
±20%	tolerance of the nominal capacitance
125 V	permissible DC operating voltage
with a semi-conductor:	I_D > 4 mA; U_{Sp} > 50 V; I_z = 5 mA; U_z = 17 V
I_D	forward current at +1 v
U_{Sp}	maximum inverse voltage
I_z	Zener current
U_z	Zener voltage

with a transformer or a coil:	Wicklg. I (1a,2a) 725 Wdg 0,3 CuL 25 Ω	Wicklg. II (4b,5b,6b) 165 Wdg 0,5 Cu2L 2,7 Ω Abgriff (5b): 138 Wdg

Wicklung I, 725 Wdg	
(1a, 2a)	725 turns, start at soldering lug 1a, end at 2a
0,3 CuL	of copper wire (Cu); 0.3 mm dia., enamel insulation (L)
25 Ω	DC resistance of winding I
Wicklung II, 165 Wdg	
(4b, 5b, 6b)	165 turns, start at soldering lug 4b, end at 6b
0,5 Cu2L	of copper wire (Cu); 0.5 mm dia., double enamel insulation (2L)
2,7 Ω	DC resistance of winding II
Abgriff (5b): 138 Wdg . . .	tap at soldering lug 5b at the 138th turn.

The Ordering Data designate clearly the component by an abbreviation code or a component specification.


Rel ms 35 K 78c (x)
Nachbeschleunig. Kontakt
AFTER ACCEL'N CONTACT
Befestig. Schelle
MOUNT'G CLAMP
Rel ms 35 K 77g
Bl. 1/SHEET 1 (x)
Rel ms 35 K 76g1a
Bl 1/SHEET 1 (x)
Rel ms 35 K 78c (x)
Rel ms 35 K 76g1a Bl. 2/SHEET 2 (x)
Rel ms 35 K 76g1a Bl. 2/SHEET 2 (x)

(x) siehe Schaltbilderteil
see wiring diagrams

Bild 1 Innenansicht des Pegelbildgeräts Rel 3 K 211g1a
FIG. 1 CHASSIS OF LEVEL TRACER

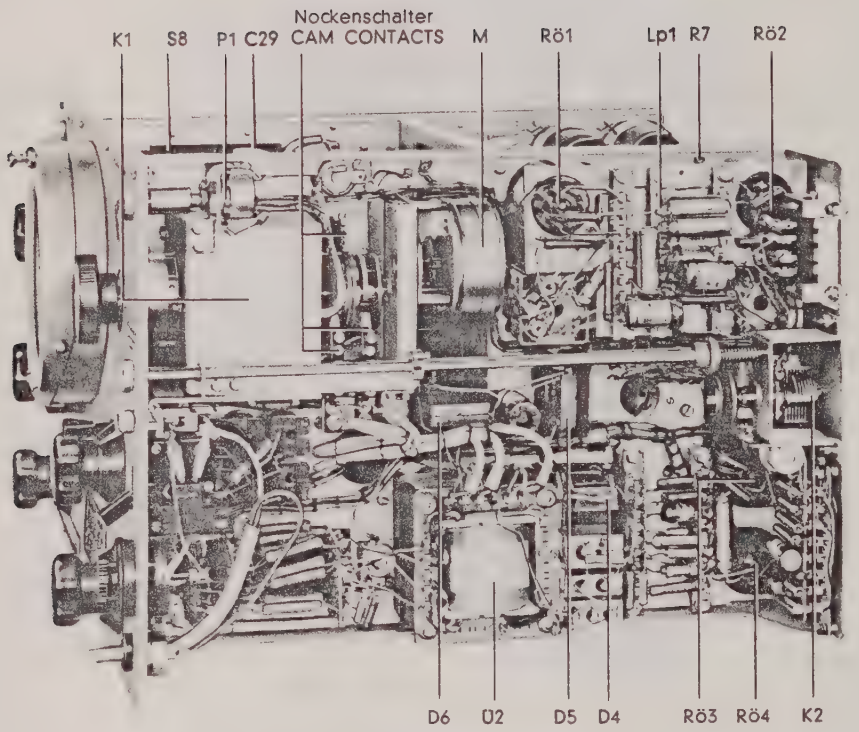


Bild 2 Sendeteil, entspricht Schaltbild Rel ms 35 K 76g1a Bl. 1

FIG. 2 TRANSMITTING SECTION, CHASSIS VIEW ACCORDING TO WIRING DIAGRAM Type Rel ms 35 K 76g1a SHEET 1

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA	Seite PAGE
	1	Senderbaugruppe TRANSMITTER SUBASSY	S45035-K76-G101	4-05
	1	Empfängerbaugruppe RECEIVER SUBASSY	S45035-K77-G101	4-10
	1	Netzteilbaugruppe POWER SUPPLY SUBASSY	S45035-K78-C701	4-15
	1	Beleuchtungsvorsatz EDGE LIGHTING ADAPTER	Rel 35K236a	4-18
		Drehknopf KNOB		
	2		C42106-A27-A6	
	5		C42106-A18-A2	
	1		C40106-A3003-A1	

Sender-Baugruppe S45035-K76-G101
TRANSMITTER SUBASSEMBLY

Ausgabe 13
ISSUE 13

C 1	1	Kf-Kondensator PLASTIC FOIL CAPACITOR 270 pF ±5% 160 V-	B31310-A1271-J
C 2, 3	2	Scheibentrimmer DISC-TYPE TRIMMER 10-60 pF	C40208-Z140-A33
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 3'	1	150 pF ±10% 160 V-	B31310-A1151-K
C 4	1	10 000 pF +0/-5% 125 V-	B31051-A1103-A009
C 5	1	1000 pF ±2,5% 160 V-	B31310-A1102-H
C 6	1	30 000 pF +0/-5% 125 V-	B31051-A1303-A009
C 7	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 25 µF +50/-20% 35 V	B 41951-B7256-S

		MP-Kondensator METALLIZED-PAPER CAPACITOR	
C 8	1	0,25µF ±20% 400V-	B25214-A4254-M
C 9/C16	1	2x0,5µF ±20% 250V-	B25174-A2105-M
C 10	1	2µF ±10% 250V-	B25214-J2205-K
C 11	1	0,5µF ±20% 250V-	B25214-A2504-M
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 12	1	250pF; 260V	B31310-A1251-K
C 13	1	100pF ±10% 160V-	B31310-A1101-K
		Papier-Kondensator PAPER CAPACITOR	
C 14	1	0,025µF ±20% 250V-	B23510-J2253-M
C 17	1	0,01µF ±20% 250V-	B23510-J2103-M
C 20	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 8µF +50/-20% 350V-	B43651-B4805-T
C 21	1	Scheibentrimmer DISC-TYPE TRIMMER 10-60pF	C40208-Z140-A33
C 21'	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 40pF ±10% 630V	B31310-A6400-K
C 22	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 33µF +50/-20% 350V-	B43691-A4336-T
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 23	1	20 000pF ±1% 125V-	B31051-A1203-F
C 29	1	120pF ±5% 160V-	B31310-A1121-J
C 30	1	Scheibentrimmer DISC-TYPE TRIMMER 2-10pF	C40208-Z140-A31
		Drossel REACTOR	
D 1	1	Wicklg. Ia (1a;4a) 1000Wdg Wicklg. Ib (2a;5a) 1000Wdg 2x0,10CuL verdr. 130Ω	V40 621 D 3018
D 2	1	254Wdg (1;2) 0,22CuL 6,7mH	V40 622 N 1020
D 3	1	216Wdg (1;2) 0,22CuL 4,86mH	V40 622 N 1021
D 4	1	6000Wdg (1a;5a) 0,06CuL ≥12H	V40 621 D 3011
D 5	1	2730 Wdg (1a;5a) 0,10CuL 28??	V40 621 D 237

D 6	1	2600Wdg (1a;3a;5a) 0,10CuL ≥14H Abgriff: 1300Wdg (3a)		V40 621 D 3010
K 2	1	Luftabgleichkondensator AIR-DIELECTRIC TRIMMER 40pF		C42208-Z3-C32
P 1	1	Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR 2kΩ lin		W40102-H8202-M001
		Schichtwiderstand LAYER-TYPE RESISTOR		
R 1	1	2kΩ ±5% 0,33W		B51264-A2202-J
		Schichtwiderstand LAYER-TYPE RESISTOR		
R 5	1	25kΩ ±0,5% 0,25W		B51265-A9253-D
		Drahtwiderstand WIRE-WOUND RESISTOR		
R 6	1	4769Ω ±0,5% 0,06	Konst. SS unif.	V40 612 D 1001
R 7	1	16738Ω ±0,5% 0,05		V40 612 D 1002
R 8/9	1	9417/5289Ω ±0,5% 0,05		V40 612 D 1003
R 10/11	1	4651/2150Ω ±0,5% 0,06		V40 612 D 1004
		Schichtwiderstand LAYER-TYPE RESISTOR		
R 12, 13	2	8kΩ ±1% 0,15W		B51264-A9802-F
R 12', 13'	2	100kΩ ±5% 0,25W		B51263-A2104-J
R 15, 26	2	500Ω ±5% 0,33W		B51264-A2501-J
R 16,19,25	3	500kΩ ±5% 0,33W		B51264-A2504-J
R 17	1	3kΩ ±5% 0,33W		B51264-A2302-J
R 18	1	80Ω ±5% 0,33W		B51264-A2800-J
R 20	1	100kΩ ±5% 0,5W		B51265-A2104-J
R 21	1	40kΩ ±5% 0,5W		B51265-A2403-J
R 22, 24	2	30kΩ ±1% 0,25W		B51265-A9303-F
R 23	1	4,7kΩ ±5% 0,33W		B51264-A2472-J
R 27	1	300Ω ±5% 0,33W		B51264-A2301-J
R 28	1	50kΩ ±5% 0,5W		B51265-A2503-J
R 29	1	1kΩ ±5% 0,5W		B51265-A2102-J
R 33 - 44	13	Siehe in S2 SEE IN S2		
S 1	1	Kleindrehschalter MIDGET ROTARY SWITCH 1-polig 26er Rast, 1 Ebene 1-POLE 26-POINT 1-DECK		C40315-M161-R226

S 2	1	Kleindrehschalter MIDGET ROTARY SWITCH 2-polig 26er Rast 2 Ebenen 2-POLE 26-POINT 2-DECKS	Rel Bv 35 K 222a Rel sch 162 nk
		darin eingebaut: CONTAINING:	
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 33, 39	2	30kΩ ±1% 0,25W	B51265-A9303-F
R 34, 40	2	16kΩ ±1% 0,25W	B51265-A9163-F
R 35, 41	2	8kΩ ±1% 0,25W	B51265-A9802-F
R 37, 43	2	450Ω ±0,5% 0,25W	B51265-A9451-D
R 38, 44	2	300Ω ±0,5% 0,25W	B51265-A9301-D
R 33'	1	9kΩ ±1% 0,15W wie eingebaut/AS MOUNTED	B51264-A9902-F
R 34'	1	2,4kΩ ±1% 0,15W wie eingebaut/AS MOUNTED	B51264-A9242-F
R 35'	1	600Ω ±1% 0,15W	B51264-A9601-F
		Übertrager TRANSFORMER	
Ü 1	1	Wicklg. I (1a;3a) 4200Wdg 0,06CuL 1940Ω Wicklg. II (1b;7b) 690Wdg 0,20CuL 34Ω Wicklg. III (4a;7a) 4200Wdg 0,06CuL 2680Ω	V40 621 E 266
Ü 2	1	Wicklg. I (3a;4d) 453Wdg 0,18CuL 33Ω Wicklg. II (4b;5b) 612Wdg 0,08CuL 235Ω Wicklg. III (3b;4b) 68Wdg 0,80CuL 0,28Ω Wicklg. IV (3a;6d) 454Wdg 0,18CuL 41Ω Wicklg. V (2b;3b) 68Wdg 0,80CuL 0,34Ω Wicklg. VI (1b;2b) 612Wdg 0,08CuL 316Ω Wicklg. VII (1d;6d) 453Wdg 0,18CuL 48Ω	V40 621 G 3007

		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 1	1	930pF ±2,5% 630V	B31310-A6931-H
C 2, 7	2	10 000pF ±10% 630V	B31310-A6103-K
C 3, 4	2	Papier-Kondensator PAPER CAPACITOR 0,05µF ±20% 250V	B23510-J2503-M
C 5	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 1250pF ±5% 630V	B31310-A6122-J500
Gr 1	4	Germanium-Diode GERMANIUM CRYSTAL DIODE	Rel TL 672 R 108
Lp 1	1	Regellampe REGULATING LAMP 70mA 40...52Ω /3,8V	V40674-A13
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1, 12	2	100Ω ±5% 0,33W	B51264-A2101-J
R 2, 11	2	100kΩ ±5% 0,33W	B51264-A2104-J
R 3, 10	2	500Ω ±5% 0,33W	B51264-A2501-J
R 4,5,8,9	4	10kΩ ±5% 0,5W	B51265-A2103-J
R 7	1	Spindel-Widerstand SPINDLE RESISTOR 100Ω 3W	B58126-K0101-A000
R 13 - 16	4	Schichtwiderstand LAYER-TYPE RESISTOR 100Ω ±0,5% 0,25W	B51263-A2101-J
		Schalenkernspule SHELL-CORE COIL	
Ü 1	1	Wicklg. I (1;3) 199Wdg 0,25CuL 4mH Wicklg. II (4;5) 80Wdg 0,25CuL 0,7mH Wicklg. IIIa (6;7) 4Wdg Wicklg. IIIb (7;8) 4Wdg 2x0,25CuL verdr.	V40 622 S 3168
Ü 2	1	Wicklg. I (1;3) 199Wdg 0,25CuL 4mH Wicklg. II (4;5) 90Wdg 0,25CuL 0,88mH Wicklg. IIIa (6;7) 3Wdg Wicklg. IIIb (7;8) 3Wdg 2x0,25CuL verdr.	V40 622 S 3169

		Motor-Baugruppe Rel 35 K 235a 1a MOTOR SUBASSEMBLY	Ausgabe 3 ISSUE 3
K 1	1	Umlaufkondensator REVOLVING CAPACITOR 1000pF ±40pF	Rel Bv 632 A 131 9 Rel ko 19e
M	1	Hochleistungs-Synchron-motor HEAVY-DUTY SYNCHRONOUS MOTOR 110V 50Hz	C44247-Z3-C1
S 8	1	Drehschalter ROTARY SWITCH 2 Schaltstellungen mit Federsatz 2 SWITCH POSITIONS WITH SET OF SPRINGS	C40315-A197-A1

		Empfänger-Baugruppe S45035-K77-G101 RECEIVER SUBASSEMBLY	Ausgabe 10 ISSUE 10
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 1	1	520pF ±1% 500V-	B31051-A5521-F
C 2	1	2000pF ±1% 500V-	B31051-A5202-F
C 3	1	Scheibentrimmer DISC-TYPE TRIMMER 10 - 60pF	C40208-Z140-A33
C 10, 19	2	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 50µF +50/-20% 35V-	B41931-A7506-S
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 11	1	5000pF ±10% 160V-	B31310-A1502-J
C 14	1	20 000pF ±5% 160V-	B31310-A1203-J
C 15a	1	30pF ±5% 630V-	B31310-A6300-J
C 15b	1	Scheibentrimmer DISC-TYPE TRIMMER 6-30pF	C40208-Z139-A30
C 16 / 17	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 2x1µF ±10% 400V-	B25184-A4205-K
C 18	1	Papier-Kondensator PAPER CAPACITOR 0,1µF ±10% 250V-	B23510-A2104-K

C 20,22,39, 40,51	5	MP-Kondensator METALLIZED-PAPER CAPACITOR 0,5µF ±20% 250V-	B25214-A2504-M
C 21,58,59, 60,61	5	Papier-Kondensator PAPER CAPACITOR 0,01 µF ±20% 250V-	B23510-A2103-M
		Papier-Kondensator PAPER CAPACITOR	
C 25, 26	2	0,08µF ±5% 250V-	B23551-A2823-J
C 27 - 30 62, 63	6	5000pF ±20% 250V-	B23510-A2502-M
C 31, 32	2	2500pF ±20% 250V-	B23510-A2252-M
C 37	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 25µF +50/-20% 35V-	B41951-B7256-S
C 38	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 1µF ±10% 250V-	B25214-J2105-K
C 43	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 10 000pF ±10% 630V-	B31310-A6103-K
C 48	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 1µF ±10% 250V-	B25214-J2105-K
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 49	1	30 000 ±1% 250V-	B31051-A2303-F
C 50	1	20 000pF ±0,5% 250V-	B31051-A2203-D
C 56, 57	2	Papier-Kondensator PAPER CAPACITOR 0,1µF ±10% 250V-	B23510-A2104-K
C 64	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR	B31310 ... max 20pF
D 1, 2	2	Drossel REACTOR	V40621 E 3016
		Wicklg. I (2a;6a) 9400Wdg 0,08CuL ≥41H	
D 3	1	212Wdg (2,5) 0,25CuL 10mH	V40622 N 3388
Gr 1,2,5,6	4	Gleichrichter RECTIFIER BAY46	Q60201-Y46

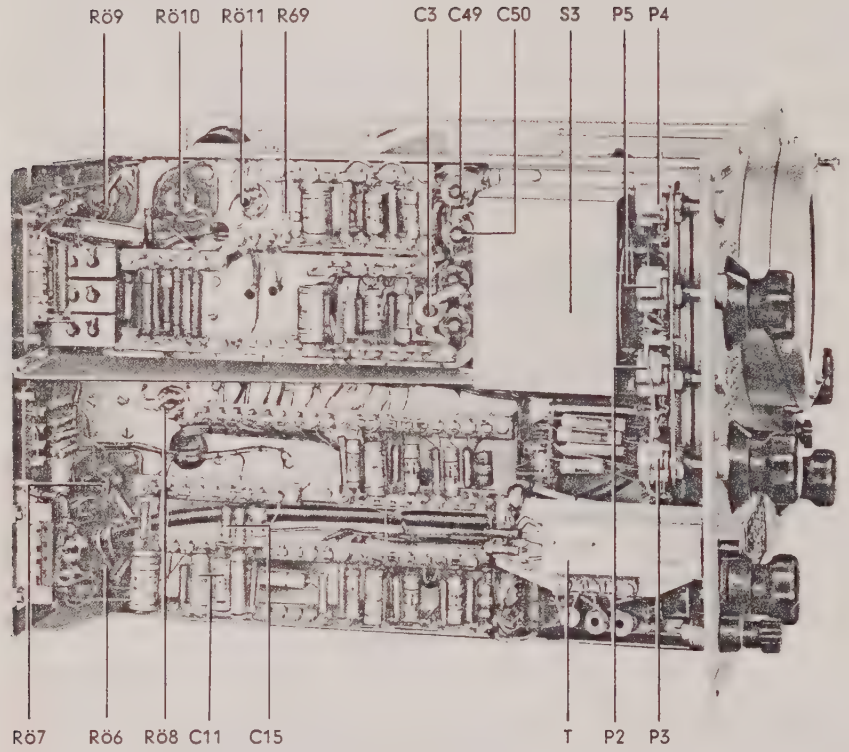


Bild 3 Empfangsteil, entspricht Schaltbild Rel ms 35 K 77g Bl. 1

FIG. 3 RECEIVING SECTION, CHASSIS VIEW ACCORDING TO WIRING DIAGRAM
Type Rel ms 35 K 77g SHEET 1

Gr 3, 4	2	Siliziumdiode SILICON DIODE SZ20KB	Q62604-K20-B
		Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR	
P 2, 3	2	100Ω lin	W40102-H8101-M001
P 4	1	1kΩ lin	W40102-H8102-M001
P 5	1	100Ω lin	W40102-H8101-
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1, 2	2	300Ω ±0,5% 1W	B51267-A9301-D
R 3	1	900Ω ±0,5% 1W	B51267-A9901-D
R 4	1	600Ω ±0,5% 0,25W	B51265-A9601-D
R 5	1	Drahtwiderstand WIRE-WOUND RESISTOR 200Ω ±5% 4W	B52365-A9201-J
R 6 - 15	10	Siehe S4 SEE S4	
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 17	1	20kΩ ±1% 0,15W	B51264-A9203-F
R 18	1	125kΩ ±5% 0,33W	B51264-A2124-J500
R 21	1	1,25kΩ ±5% 0,33W	B51264-A2122-J500
R 22	1	60Ω ±5% 0,33W	B51264-A2122-J500
R 23,48,49	3	100Ω ±5% 0,33W	B51264-A2101-J
R 24	1	2MΩ ±5% 0,33W	B51264-A2205-J
R 26	1	50kΩ ±5% 0,33W	B51264-A2503-J
R 27	1	125kΩ ±1% 0,15W	B51264-A9124-F500
R 28	1	200kΩ ±5% 0,5W	B51265-A2204-J
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 29	1	20kΩ ±5% 0,33W	B51264-A2203-J
R 30,46,47, 52,62, 81,82	7	500kΩ ±5% 0,33W	B51264-A2504-J
R 31, 64	2	500Ω ±5% 0,33W	B51264-A2501-J
R 32	1	400Ω ±5% 0,33W	B51264-A2401-J
R 33	1	50kΩ ±5% 0,5W	B51265-A2503-J
R 40, 41, 75, 76	4	125kΩ ±1% 0,25W	B51265-A9124-F500

R 42, 43 77, 78	4	100kΩ ±2% 0,33W	B51264-A2104-G
R 44, 45 79, 80	4	250kΩ ±5% 0,33W	B51264-A2254-J
R 51	1	125kΩ ±5% 0,33W	B51264-A2124-J500
R 53, 65	2	300Ω ±5% 0,33W	B51264-A2301-J
R 54	1	8kΩ ±5% 0,33W	B51264-A2802-J
R 55	1	50kΩ ±5% 1W	B51266-A2503-J
R 56	1	100kΩ ±5% 1W	B51266-A2104-J
R 57	1	10kΩ ±5% 0,33W	B51264-A2103-J
R 66	1	1,8kΩ ±5% 1W	B51266-A2182-J
R 67	1	20kΩ ±5% 1W	B51266-A2203-J
R 68	1	10kΩ ±0,5% 1W	B51267-A9103-D
R 69	1	29kΩ ±1% 0,25W	B51265-A9293-F
R 70	1	1kΩ ±1% 0,15W	B51265-A9102-F
		Kleindrehschalter MIDGET ROTARY SWITCH	
S 3	1	2-polig 26er Rast 2 Ebenen 2-POLE 26-POINT 2-DECKS	V42261-A64-B1
S 4	1	1-polig 26er Rast 1 Ebene 1-POLE 26-POINT 1-DECK	Rel Bv 35 K 159
		darin eingebaut: CONTAINING:	
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 6, 7	2	60kΩ ±0,5% 0,25W	B51265-A9603-D
R 8	1	19kΩ ±0,5% 0,25W	B51265-A9193-D
R 9	1	3,84kΩ ±0,5% 0,25W	B51265-A9382-D400
R 10	1	2,16kΩ ±0,5% 0,25W	B52165-A9212-D600
R 11	1	1,21kΩ ±0,5% 0,25W	B51265-A9122-D100
R 12	1	683Ω ±0,5% 0,25W	B51265-A9681-D300
R 13	1	600Ω ±0,5% 0,25W	B51265-A9601-D
R 14	1	278Ω ±0,5% 0,25W	B51265-A9271-D800
R 15	1	1kΩ ±1% 0,15W	B51264-A9102-F
S 5	1	Kleindrehschalter MIDGET ROTARY SWITCH 1-polig 26er Rast 1 Ebene 1-POLE 26-POINT 1-DECK	C40315-M163-R226

T	1	Drucktaste mit Federsatz und Knopf PUSHBUTTON WITH SPRING SET AND BUTTON	V30188-X2640-X
		Übertrager TRANSFORMER	
Ü 1	1	Wicklg. I (7;6;9) 3000Wdg 0,08Cu2L ≈ 900Ω Abgriff: 550Wdg (6)	V40 621 E 3112
		Wicklg. II (1;2) 750Wdg 0,18CuL ≈ 44,5Ω	
		Wicklg. III (4;5) 750Wdg 0,18CuL 44,5Ω	
Ü 2, 3	2	Wicklg. I (4a;5a) 600Wdg	V40621D 3154
		Wicklg. II (1b;3b;5b) 50Wdg 0,12CuL ≥3,7mH Abgriff: 35Wdg (3b)	
		Wicklg. III (1a;2a) 600Wdg	

Netzteil-Baugruppe S45035-K78-C701
POWER SUPPLY SUBASSEMBLY

Ausgabe 12
ISSUE 12

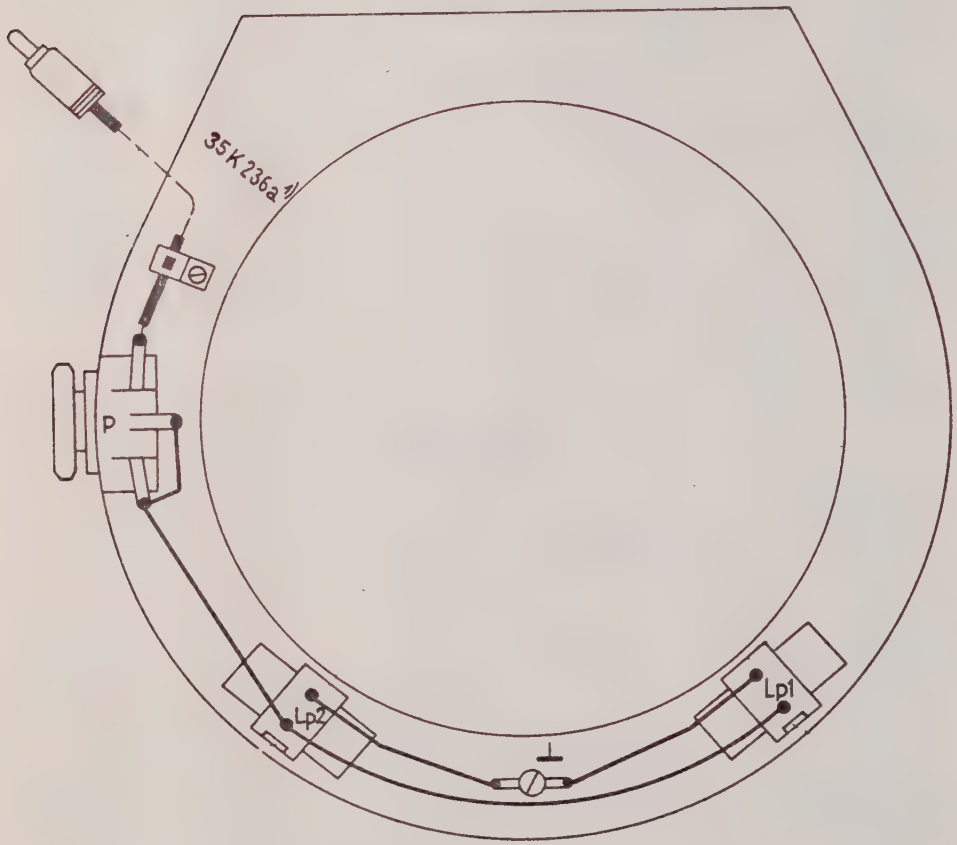
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 2	1	300pF ±10% 300V-	B31310-A6301-K
C 3	1	50pF ±10% 160V-	B31310-A1500-K
C 4	1	Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR 25µF +50/-20% 35V-	B41951-B7256-S
		Papier-Kondensator PAPER CAPACITOR	
C 5	1	0,1µF ±10% 250V-	B23510-A2104-K
C 10	1	5000µF ±20% 1000V-	B23500-J9502-M
C 11	1	Wulstrohr-Kondensator BEAD-EDGED TUBULAR CAPACITOR 700pF ±10% 2kV	C44208-Z3-C1
		Papier-Kondensator PAPER CAPACITOR	
C 13	1	0,5µF ±10% 1V-	B21092-B0504-K
C 14	1	5000pF ±20% 1000V-	B23500-J9502-M
C 16	1	0,01µF ±20% 250V-	B23500-J2103-K

		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 20, 21	2	32+32µF +30/-10% 350V-	B43731-A4646-Q
C 22	1	32µF +50/-20% 350V-	B43691-A4326-Q
C 23	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 2µF ±10% 160V-	B25212-J2205-K
C 24	1	Scheibentrimmer DISC-TYPE TRIMMER 2-10pF 10V	C40208-Z140-A27
D 1	1	Siebdrossel FILTER CHOKE	V40 621 F 136
		Wicklg. I (4a;5a) 5000Wdg 0,16CuL ≧10H	
D 2		Wicklg. I (1;5) 2650Wdg 0,20CuL ≧3,4H	V40 621 E 3102
		Stabgleichrichter ROD-TYPE RECTIFIER	
Gr 3	1	1000V 3mA	Q70-H0420
Gr 4	1	1000V 8mA	Q70-H0470
Gr 5, 6	2	2000V 2,5mA	Q70-H0423
Gr 7, 8	2	Flachgleichrichter FLAT-TYPE RECTIFIER 390V 170mA	Q70-F1143
Lp 2, 3	2	Regellampe REGULATING LAMP 70mA 40-52Ω	V40674-A13
		Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR	
P 6	1	100kΩ lin	W40104-C8104-M001
P 7	1	1MΩ lin	W40104-C8105-M001
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1	1	30Ω ±1% 0,25W	B51265-A9300-F
R 3	1	100Ω ±1% 0,25W	B51265-A9101-F
R 4	1	Drahtwiderstand WIRE-WOUND RESISTOR 5Ω ±10%	Rel Bv 612 K 17
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 5	1	16Ω ±1% 0,25W	B51265-A9160-F
R 6, 7	2	500Ω ±5% 0,33W	B51264-A2501-J

R 8	1	160Ω ±5% 0,33W	B52164-A2161-J
R 9	1	10kΩ ±5% 2W	B51404-A2103-J
R 14, 15	2	300kΩ ±5% 0,5W	B51265-A2304-J
R 16	1	100kΩ ±5% 0,33W	B51264-A2104-J
R 17	1	1,6MΩ ±5% 0,5W	B51265-A2165-J
R 19	1	70kΩ ±5% 0,33W	B51264-A2703-J
R 25 - 28	4	5MΩ ±5% 0,33W	B51264-A2505-J
S 6, 7	2	Netzkippschalter POWER SWITCH 2-polig 6A 250V-	C40315-A171-A1
Tr	1	Netztrafo POWER TRANSFORMER Wicklg. I (4a;6a) 100Wdg 0,55CuL 10Ω Wicklg. II (2a;4a) 550Wdg 0,45CuL 10Ω Wicklg. III (1a;3a) 550Wdg 0,45CuL 11Ω Wicklg. IV (6b;7b;8b) 2820Wdg 0,16CuL 515Ω Abgriff (7b): 1410Wdg Wicklg. V (5d;6d) 56Wdg 0,85CuL 0,37Ω Wicklg. VI (4d;5d) 35Wdg 1,00CuL 0,17Ω Wicklg. VII (3d;4d) 21Wdg 0,85CuL 0,15Ω Wicklg. VIII (1b;2b) 35Wdg 0,40CuL 1,1Ω	V40621 L 3007
Ü 1	1	Übertrager TRANSFORMER Wicklg. I (1;2) 5Wdg 0,30CuL Wicklg. II (5;6) 493Wdg 0,16CuL 151 ±5mH	V40 622 S 68
Ü 2	1	Übertrager TRANSFORMER Wicklg. I 2x0,20Cu2L Ia: 16Wdg (7;0) >0,85Ω Ib: 16Wdg (0;8) >0,85Ω Wicklg. II (1;2) 75Wdg 0,10CuL Wicklg. III (0;4;3) 3Wdg 0,20Cu2L Abgriff (4): 1Wdg Wicklg. IV 600Wdg 0,20Cu2L 71 +1% mH Abgriff (6): 500Wdg	V40622 R 3008

P	1	Drahtdrehwiderstand WIRE-WOUND VARIABLE RESISTOR	W40109-C8470-K008

REAR VIEW
Rückansicht



Liste der mechanischen Ersatzteile
LIST OF MECHANICAL SPARE PARTS

Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
5	Drehknöpfe für S1 bis S5 CONTROL KNOBS FOR S1 TO S5	C42106-A18-A2
1	Drehknopf für K1 CONTROL KNOB FOR K1	C40106-A3003-A1
2	Isolierknöpfe INSULATING KNOBS	C40106-A94-A6
1	Erdklemme GROUND TERMINAL	M95004-E10
2	Buchsenplatten JACK PLATES	C40205-B6-A1
1	Buchsenplatte JACK PLATE	C40205-B6-A2
1	Buchsenplatte JACK PLATE	C42334-A175-A10
	dazu IN ADDITION	
1	Federsatz SPRING SET	C20209-A23-A3
1	Buchsenplatte JACK PLATE	C40205-B6-A59
	dazu IN ADDITION	
4	Federsätze SPRING SETS	C20209-A23-A1
1	Kabeldurchführung CABLE LEAD-THROUGH UNIT	C40121-B20-A3
1	Umstecksicherung bestehend aus: RELOCATE FUSE CONSISTING OF:	
	1 Schraubkappe SCREW CAP	C42327-Z9-C1
	1 Gehäuse CASING	C42327-Z9-C2
	1 Stecker PLUG	C42327-Z9-C4
	1 Schild PLATE	C42327-Z9-C5
	1 Schild beschriftet nach PLATE LETTERED ACCORDING TO	S45034-K211-Z17

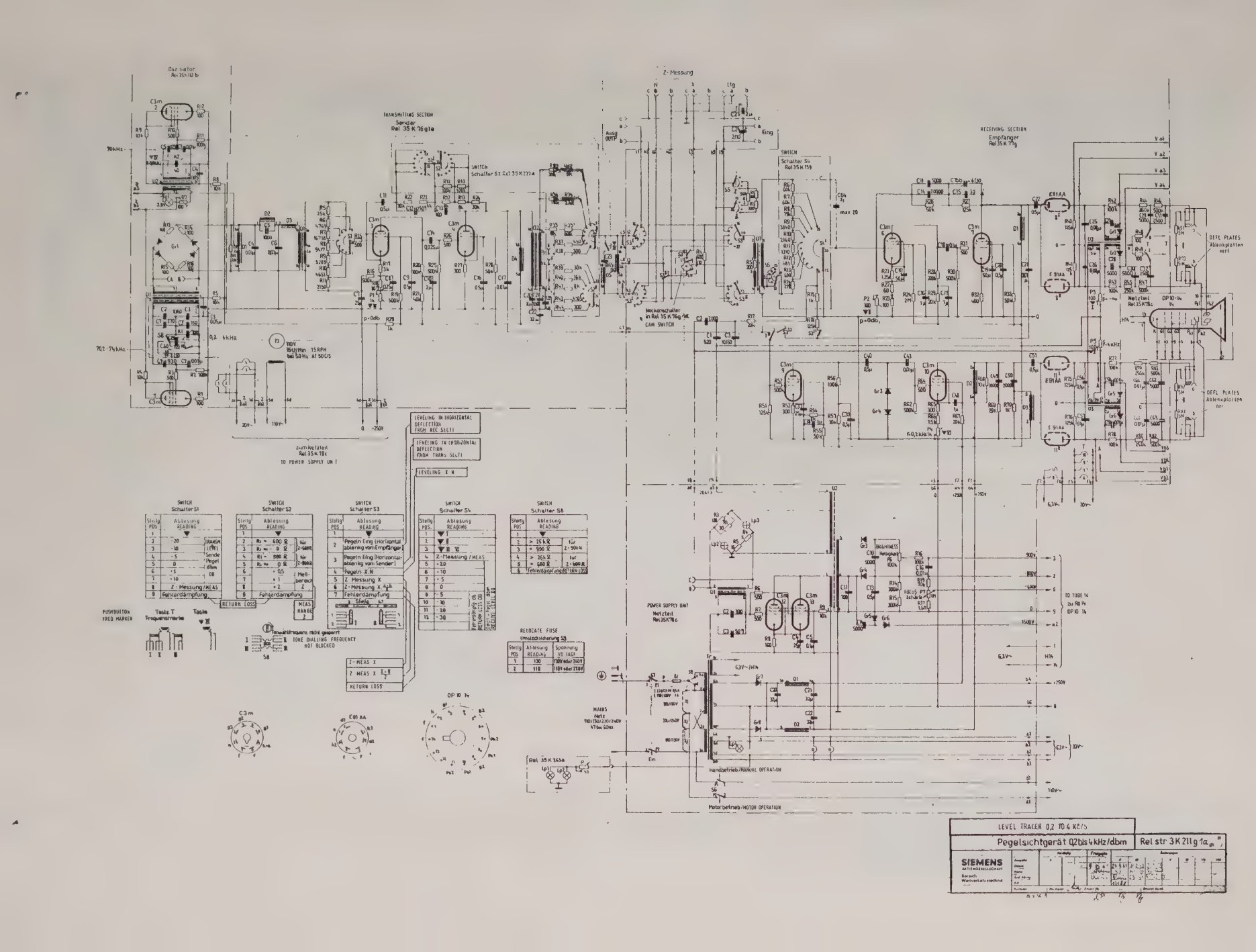
1	Lampenfassung für Lp4 LAMP SOCKET FOR LAMP 4	C42230-A3-A1
1	Skalendeckel SCALE LID	C40249-A253-B26
10	Fassungen für Röhren C3m SOCKETS FOR TUBES C3m	C40230-B12-A1
2	Fassungen für Röhren EAA91 SOCKETS FOR TUBES EAA91	C40334-A127-A4
1	Fassung für Kathodenstrahl-röhre DP 10 - 14 SOCKET FOR CATHODE RAY TUBE DP 10 - 14	C42334-F3-C32
1	Schelle für DP 10 - 14 CLAMP FOR DP 10 - 14	Relmse 253, T327
1	Nachbeschleunigungs-Kontakt für DP 10 - 14 AFTER-ACCELERATION CONTACT FOR DP 10 - 14	Q81-X9009
2	Nockenscheiben CAM DISKS	C40249-A253-C200
1	Nockenscheibe CAM DISK	C40249-A253-C202
	zu den Nockenscheiben je 1 Federsatz 1 SPRING SET PER CAM DISK	C20209-A23-A1
	Zur Befestigung des Gerätes im Blechgehäuse FOR FASTENING THE DEVICE IN THE SHEET-METAL CABINET	
4	Linsenschrauben OVAL FILLISTER-HEAD CAP SCREWS	D85-P120-S1
4	Scheiben WASHERS	D125-A43-M37
2	Führungsstifte GUIDING PINS	C40249-A253-C326
2	Sechskantmuttern HEX NUTS	D439-B50-M37
2	Federringe LOCK WASHERS	137-B50-R60
4	Druckstücke CLAMPING PIECE	C40123-A29-A3
4	Linsenschrauben OVAL FILLISTER-HEAD CAP SCREWS	D85-Q120-S1
1	Nockenscheibe CAM DISK	C40249-A253-C201

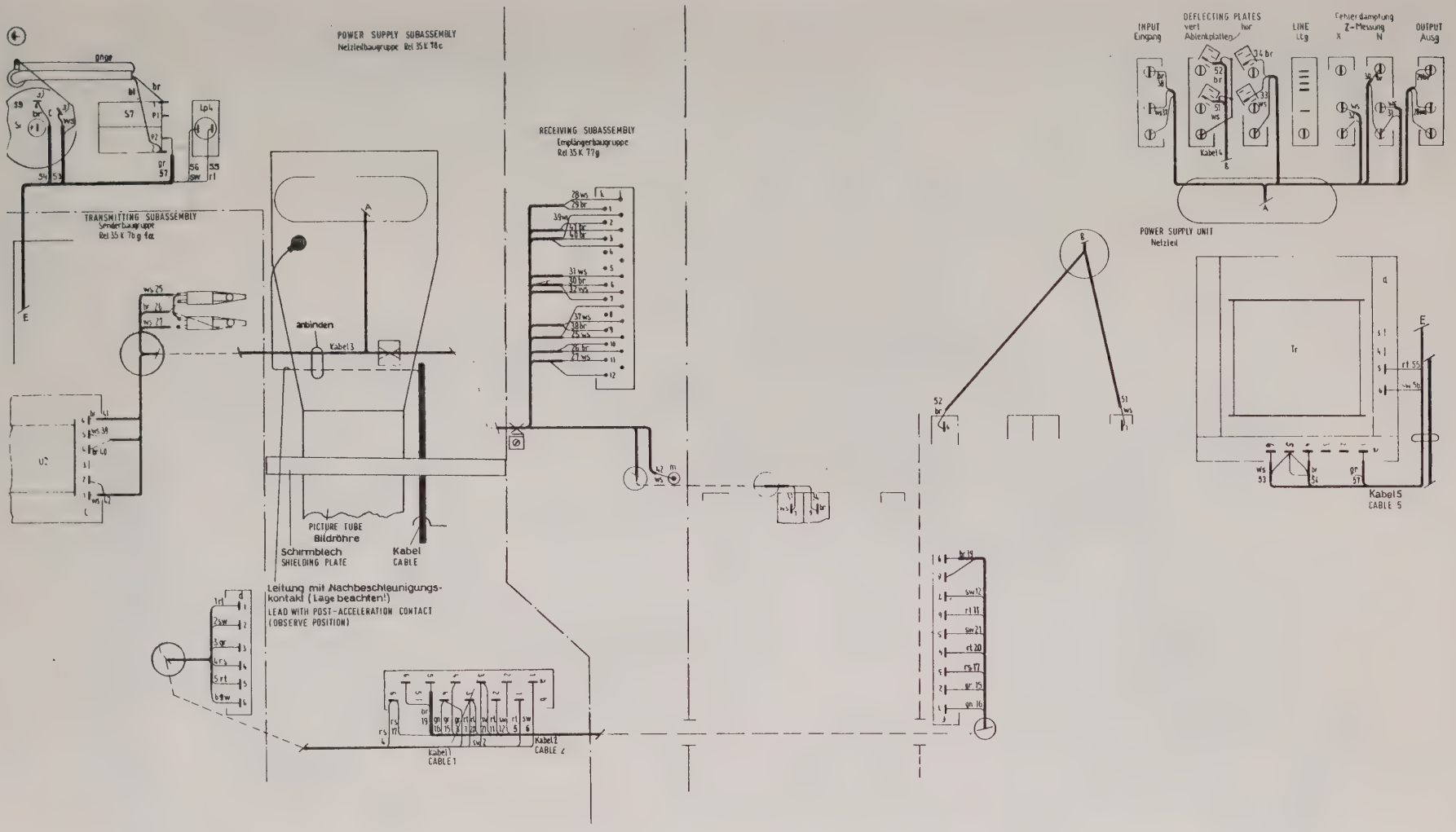
4	Scheiben WASHERS	D125-A53-M648
	Zum Blechgehäuse: FOR SHEET-METAL CABINET:	C44165-A6-A1
2	Griffe HANDLES	C44165-A24-B163
4	Verschlüsse kompl. LOCKS	C40123-A18-A2
1	Netzanschlußleitung POWER CORD	V404594-F4-A722

CIRCUIT AND WIRING DIAGRAMS

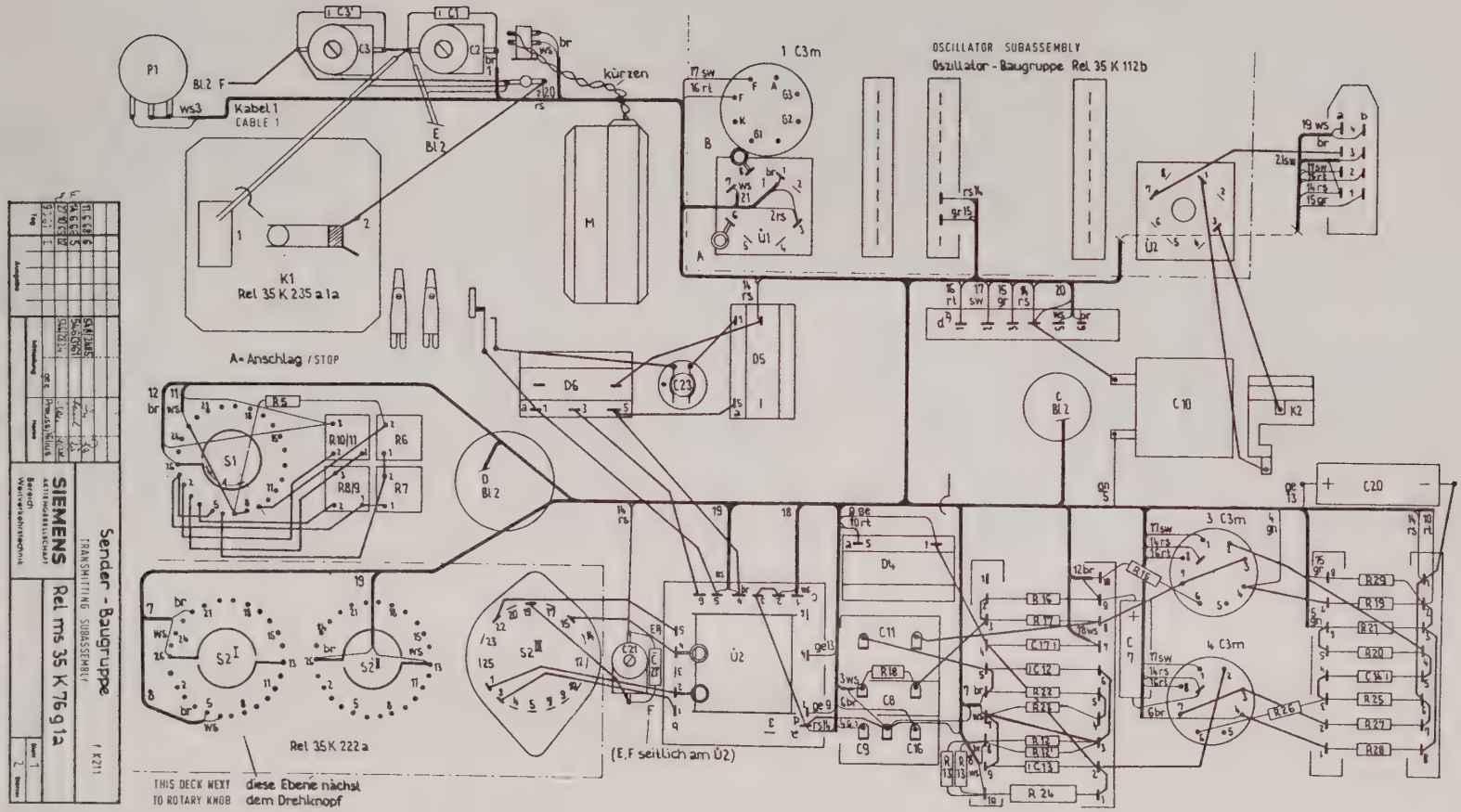
C O N T E N T S

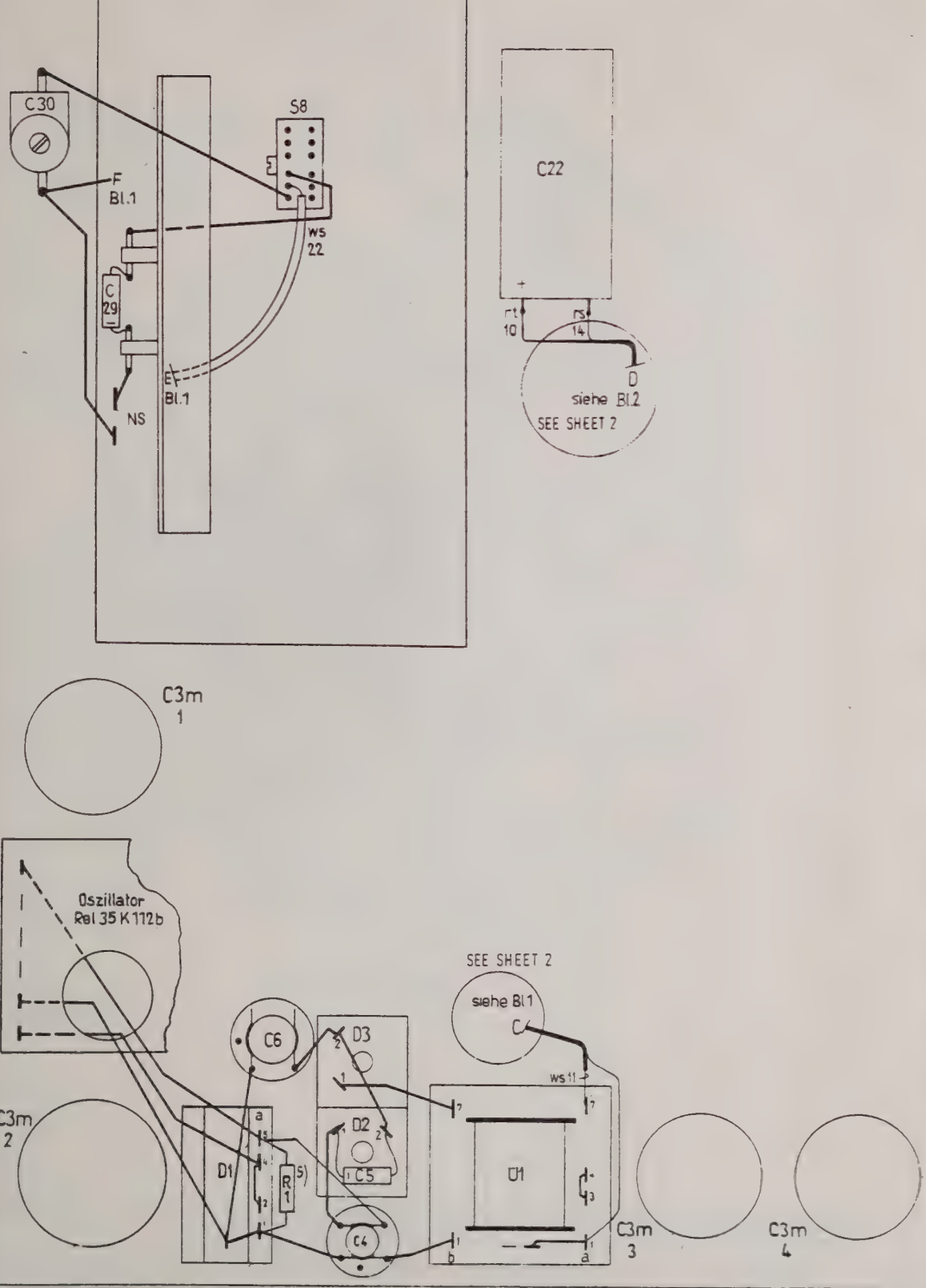
LEVEL TRACER	S45034-K211-G214
CIRCUIT DIAGRAM	Rel str 3 K 211g 1a
WIRING DIAGRAM	Rel ms 3 K 211g 1a
TRANSMITTING SUBASSEMBLY	S45035-K76-G101
WIRING DIAGRAM	Rel ms 35 K 76g 1a (2 SHEETS)
RECEIVING SUBASSEMBLY	S45035-K77-G101
WIRING DIAGRAM	Rel ms 35 K 77g (3 SHEETS)
POWER SUPPLY SUBASSEMBLY	S45035-K78-C701
WIRING DIAGRAM	Rel ms 35 K 78c


Oszillator
Rel 35 K 12 b
TRANSMITTING SECTION
Sender
Rel 35 K 76 g1a
RECEIVING SECTION
Empfänger
Rel 35 K 77 g
Z-Messung
SWITCH
Schalter S2 Rel 35 K 223 a
SWITCH
Schalter S4
Rel 35 K 159
Wechselschalter
Rel 35 K 76 g 4a
CAM SWITCH
zum Netzteil
Rel 35 K 78 c
TO POWER SUPPLY UNIT
LEVELING IN (HORIZONTAL DEFLECTION FROM REC SECT)
LEVELING IN (HORIZONTAL DEFLECTION FROM TRANS SECT)
LEVELING X M
SWITCH
Schalter S1
SWITCH
Schalter S2
SWITCH
Schalter S3
SWITCH
Schalter S4
SWITCH
Schalter S5
RELOCATE FUSE
Umsteicksicherung S5
Pegeln Eing (Horizontalablenkg vom Empfänger)
Pegeln Eing (Horizontalablenkg vom Sender)
Pegeln Z M
Z Messung X
Z Messung X
Fehlerdämpfung
Z-MEAS X
Z MEAS X
RETURN LOSS
PUSHBUTTON FREQ MARKEN
Taste T
Frequenzmarken
Taste
TONE DIALLING FREQUENCY NOT BLOCKED
Tonwahlfrequenz nicht gesperrt
MEAS RANGE
POWER SUPPLY UNIT
Netzteil
Rel 35 K 78 c
MAINS
Netz
HANDBETRIEB/MANUAL OPERATION
Motorbetrieb/MOTOR OPERATION
TO TUBE 14
zu Rö 14
DP 10 14
DEFL PLATES
Ablenkplatten
vert
hor
Rel 35 K 263 a
LEVEL TRACER 0,2 TO 4 KC/S
Pegelsichtgerät 0,2 bis 4 kHz/dbm
Rel str 3 K 211 g 1a
SIEMENS
AKTIENGESELLSCHAFT


POWER SUPPLY SUBASSEMBLY
Netzteilbaugruppe Rel 35 K 78 c
RECEIVING SUBASSEMBLY
Empfängerbaugruppe
Rel 35 K 77 g
TRANSMITTING SUBASSEMBLY
Senderbaugruppe
Rel 35 K 76 g 1 a
anbinden
Kabel 3
PICTURE TUBE
Bildröhre
Schirmblech
SHIELDING PLATE
Kabel
CABLE
Leitung mit Nachbeschleunigungs-kontakt (Lage beachten!)
LEAD WITH POST-ACCELERATION CONTACT (OBSERVE POSITION)
Kabel 1
CABLE 1
Kabel 2
CABLE 2
INPUT
Eingang
DEFLECTING PLATES
vert
Ablenkplatten
hor
LINE
Ltg
Fehlerdampfung
Z-Messung
X
N
OUTPUT
Ausg
Kabel 4
POWER SUPPLY UNIT
Netzteil
Tr
Kabel 5
CABLE 5

| | | |


OSCILLATOR SUBASSEMBLY
Oszillator - Baugruppe Rel 35 K 112b
Sender - Baugruppe
TRANSMITTING SUBASSEMBLY
SIEMENS
Rel ms 35 K 76 g 1a
Rel 35 K 222a
K1
Rel 35 K 235 a 1a
A = Anschlag / STOP
Kabel 1
CABLE 1
kürzen
1 C3m
3 C3m
4 C3m
C20
C10
K2
D5
D6
D4
C11
C8
C9
C16
R18
R 24
R 26
R29
R19
R21
R20
R25
R27
R28
(E,F seitlich am Ü2)
THIS DECK NEXT TO ROTARY KNOB
diese Ebene nächst dem Drehknopf



Sender-Baugruppe

TRANSMITTING SUBASSEMBLY

f K211

Rel ms 35K 76 g1a Bl 2 (2 Bl)

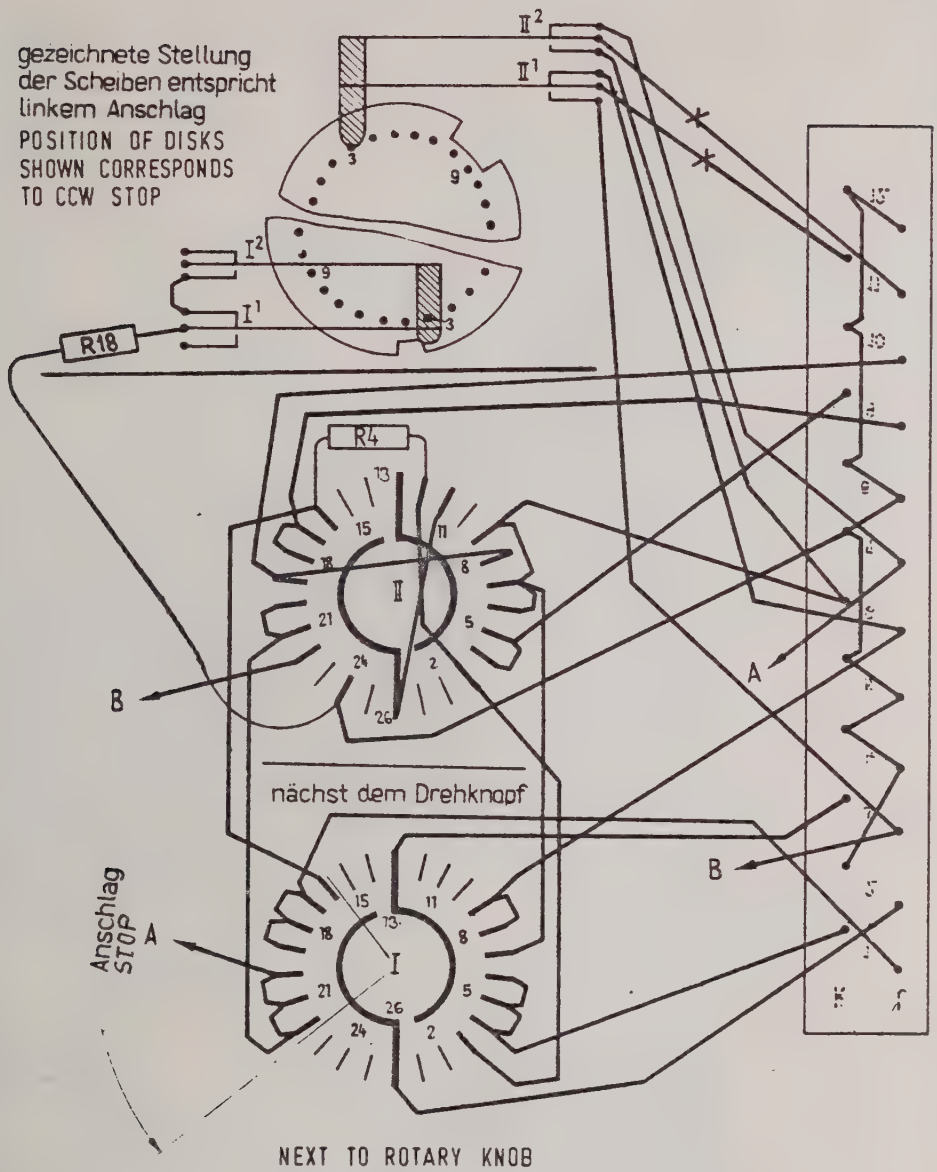
SIEMENS AKTIENGESELLSCHAFT

Bereich Weitverkehrstechnik

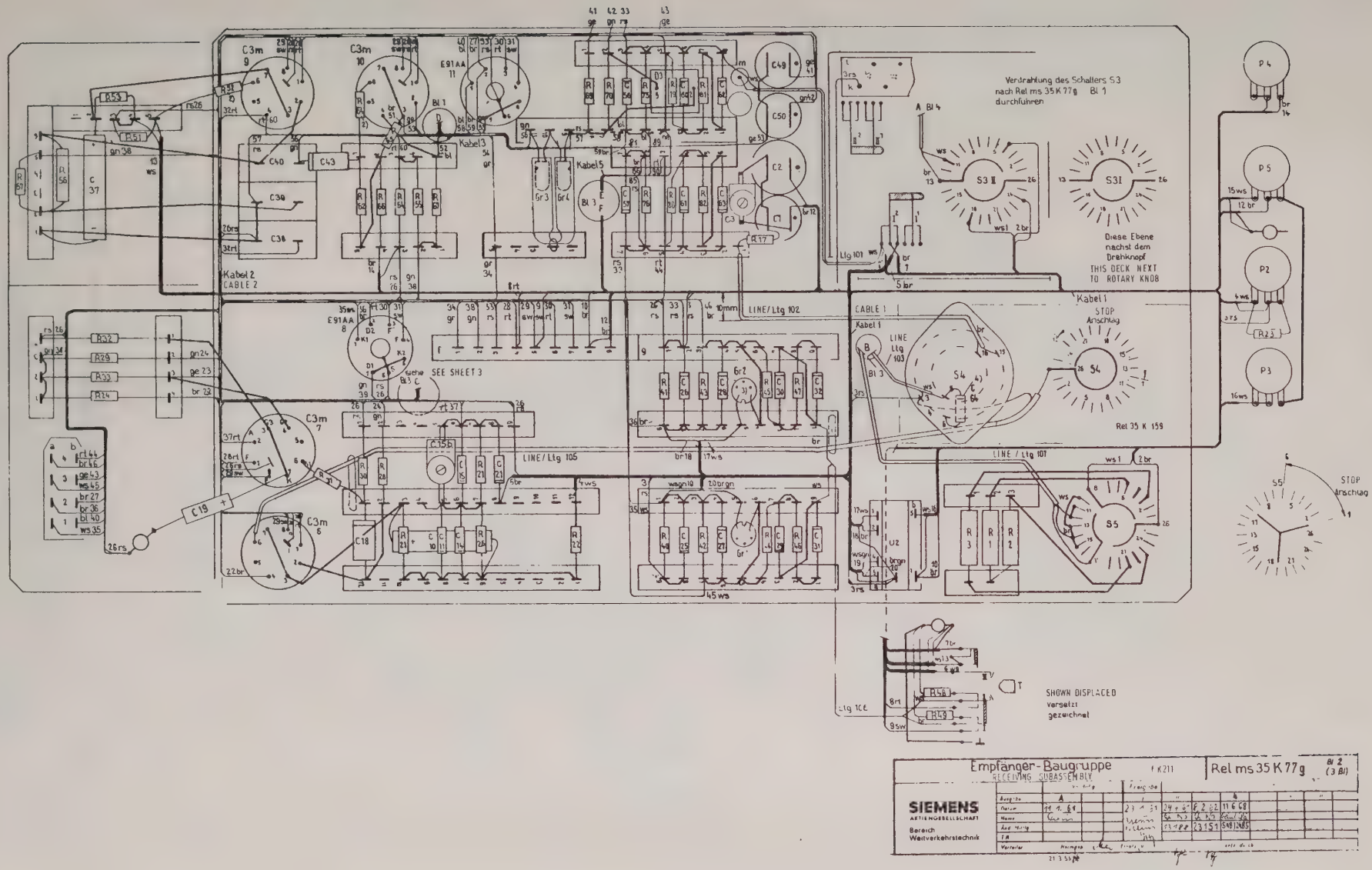
| | | |

WIRING OF SWITCH S3

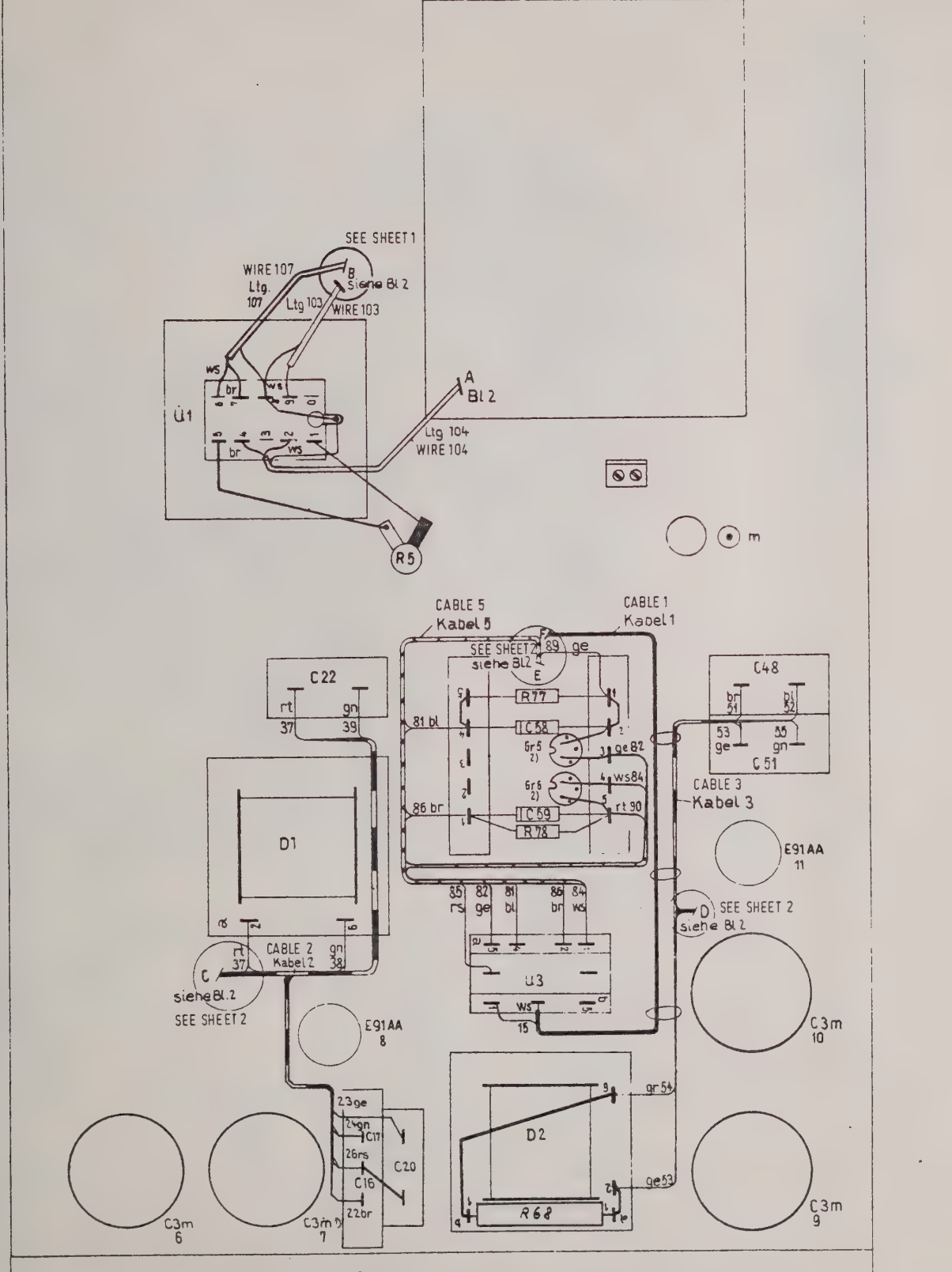
Verdrahtung des Schalters S3



| | | |


Verdrahtung des Schalters S3
nach Rel ms 35 K 77 g Bl 1
durchführen
Diese Ebene
nächst dem
Drehknopf
THIS DECK NEXT
TO ROTARY KNOB
Kabel 1
CABLE 1
Kabel 2
CABLE 2
Kabel 3
Kabel 5
LINE/Ltg 102
LINE/Ltg 105
LINE/Ltg 107
LINE
Ltg 103
STOP
Anschlag
SEE SHEET 3
SHOWN DISPLACED
versetzt
gezeichnet
Rel 35 K 159

| | | |



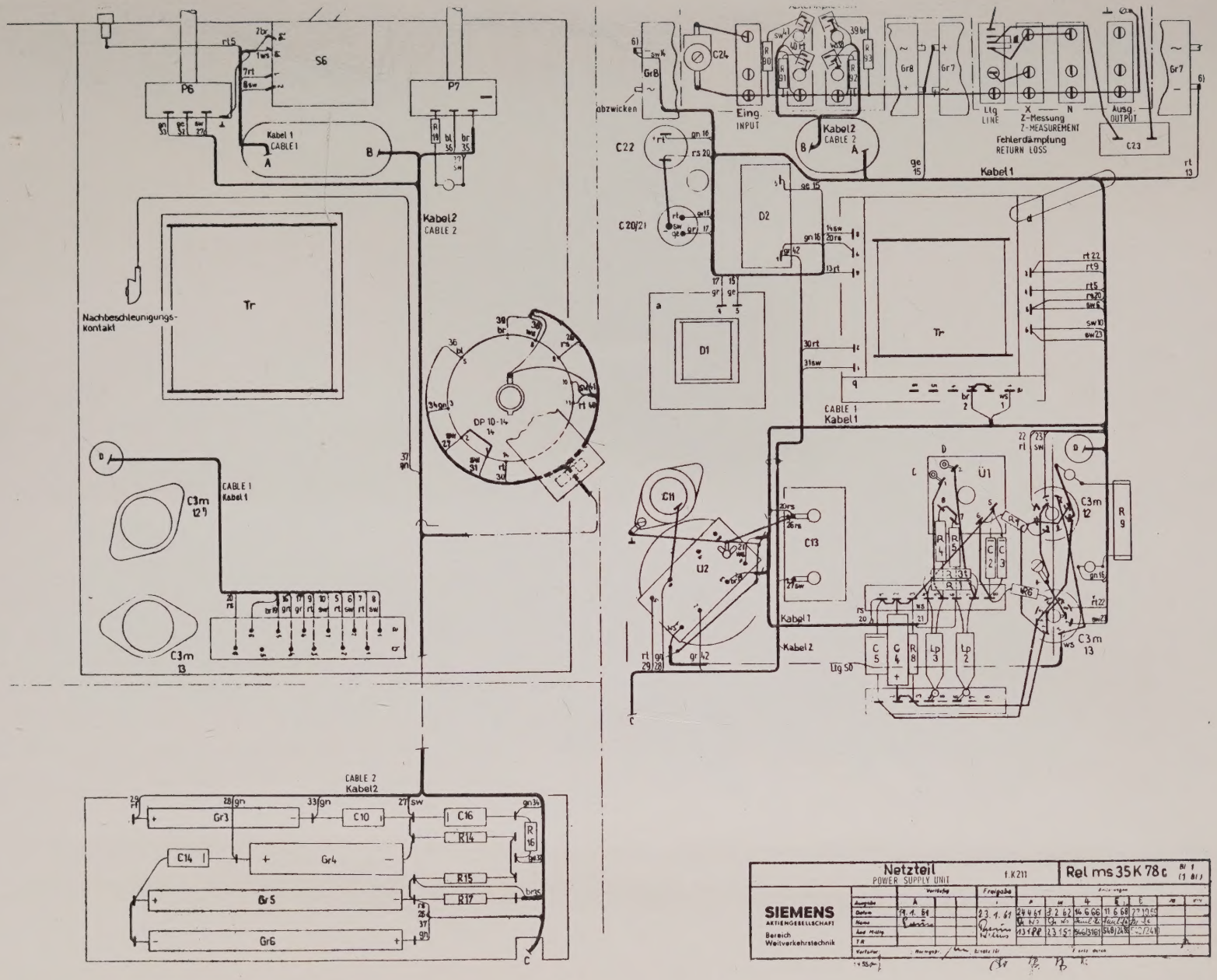
Empfänger Baugruppe	f. K211	Rel ms 35 K 77 g	Bl 3 (3 Bl.)
RECEIVING SUBASSEMBLY			

SIEMENS AKTIENGESELLSCHAFT
Bereich Weitverkehrstechnik

	verifiz'g A	B	C	Freigabe I	Änderungen II	III	IV	V	VI	VII	VIII
Ausgabe											
Datum	11. 1. 67			23. 1. 67	29.7.67	11.6.68					
Name	Quirin			Quirin	Dr. Nr.	Feuerle					
Amt Abtlg.					-3309	548/2485					
T.B.				Nelum							
Verfasser	Name			Prüfer Nr.		Erstellt durch					

140

12.7.65 ZD


S6
P6
P7
Kabel 1
CABLE 1
Kabel2
CABLE 2
Tr
Nachbeschleunigungs-
kontakt
DP 10-14
C3m
12
C3m
13
CABLE 1
Kabel 1
CABLE 2
Kabel2
Gr3
C10
C16
R14
C14
Gr4
R15
Gr5
R17
Gr6
C24
Gr8
Gr7
Eing.
INPUT
Ltg
LINE
X
Z-Messung
Z-MEASUREMENT
N
Fehlerdämpfung
RETURN LOSS
Ausg.
OUTPUT
C23
C22
C20/21
D2
D1
Tr
Kabel 1
Kabel 2
C11
U2
C13
Ü1
C3m
12
C3m
13
Ltg 50
C5
C4
R8
Lp3
Lp2

| | | |